LEFFEL

TURBINE WATER WHEELS

BULLETIN 54

THE JAMES LEFFEL & CO.
SPRINGFIELD, OHIO.
U.S.A.

A. S. Robeson

LEFFEL
TURBINE
WATER WHEELS

BULLETIN 54

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THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO, U. S. A.

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BULLETIN 54

THIS Bulletin illustrates and describes in detail our two principal types of turbines, our Standard SAMSON and TYPE Z turbines. We also illustrate in this Bulletin several latest designs of hydro installments equipped with our SAMSON and TYPE Z turbines. We also build many other types and designs of turbines for low, medium and high heads and of reduced, medium and high powers and speeds for both vertical and horizontal installments.

Our STANDARD SAMSON TURBINES are equipped with our latest type of double bucket runners and are illustrated and described in detail on pages 6 to 13 inclusive. We have built these Samson turbines for several years. Also, we build this type of turbine of many other different power, speed and efficiency values.

Our TYPE Z TURBINES are illustrated and described on pages 14 to 19 inclusive. These turbines installed under low and medium heads are especially adapted for direct connection to electric generators, exciters, centrifugal pumps, grinders and other high-speed machinery.

We also design and build FRANCIS type turbines for medium and high heads, with scroll or volute casings, single and double discharge designs, developing various power and speed values. We were the first hydraulic engineers to build and install turbines at Niagara Falls, under the full head of water of about 210 feet. These turbines are horizontal designs, both ends of turbine shafts direct connected to generators. These turbines are thoroughly commercial and most successful in every particular, and developing high efficiencies at all gateages.

Our Engineering and Manufacturing Departments are experts in turbine designing and how best to construct the complete installment for developing maximum results at lowest initial cost and minimum operating expenses. The many highly successful hydro installments using our various types and designs of turbines, prove these claims absolutely.

When considering new turbines, advise us with as much information pertaining to same as possible. Our engineers are prepared to inspect your location and requirements. We will promptly submit drawings and proposals for turbines which we would recommend as best adapted.

We have thousands of our turbines installed and in successful operation all over the world. We have been continuously building turbine water wheels since the establishment of this business in 1862. During all of these years we have actively applied our resources to the development and improvement of our turbines and installment of same.

When correctly installed and operated we fully guarantee our turbines.

Established 1862

LEFFEL Turbine Water Wheel Shops

Our shops are located in the immediate vicinity of many large rolling mills, blast furnaces, steel foundries, forges and coal mines, from which we obtain the highest grade materials used by us in the building of our turbines and other machinery.

We have all of the principal railroad connections directly into our shops, insuring rapid handling and transportation of both domestic and foreign shipments. Our Traffic Department will secure lowest freight rates and best routing for all of our shipments, via railroad or steamship, to any shipping point in the world.

Our shops are especially designed and constructed for the rapid building of our various types of turbines. Our workmen with years of experience are skilled in the building of our turbines, insuring high-grade workmanship throughout. Each department is fully equipped with special tools and machinery driven electrically by our own power plant. We give all orders our most prompt and careful attention.

LEFFEL GUARANTEE

We guarantee the workmanship and material used by us in the construction of our turbines to be strictly first class throughout. Also, we guarantee our turbines and machinery to be our latest designs of their respective types, built strong and substantial in all details.

Furthermore, we guarantee the power, speed and efficiency values of our turbines when they are correctly installed and operated.

Furthermore, we guarantee to furnish within one year after shipment, free of cost, on cars our shops, any part of our turbines that may prove defective because of improper material or design.

Holyoke and Power Plant Tests

THE Holyoke Water Power Company, in their testing flume at Holyoke, Mass., have tested, during the past twenty-five years or more, many of our various types and capacities of turbines. The latest Holyoke tests of our improved turbines developed results heretofore unequaled, highest speeds, highest horsepowers, highest efficiencies.

We have many power plant tests of our vertical and horizontal turbines installed and operating under different conditions and duties. These tests were made not only for power, speed and efficiency values, but also to determine the strength and adaptability of the turbines, together with speed regulation results.

Using these various tests, together with our turbine experience of over fifty-four years, we design and build our turbines to develop the highest hydraulic and best commercial values.

Our improved turbine runners are of the strongest and highest efficiency construction. We have hundreds of these runners operating successfully, under extremely heavy load changes and severe power plant conditions and requirements, proving the superior strength and efficiency construction of our runners.

Our improved gate casings are strongly built and of simplest designs, fitted with easy moving, balanced swing-type gates. Frequently, to meet special requirements, the gates, links and all moving parts are bronze bushed. The gates are independently adjustable and removable.

Thrust bearings that carry the revolving parts of our turbines are designed from long, practical experience and extensive Holyoke and power plant tests in which the weight of the turbine revolving parts and water thrust were accurately weighed and carefully calibrated.

Correctly designed waterways, penstocks and draft-tubes are absolute requirements for developing maximum hydraulic values. We have many of these tests which we use for designing high efficiency installments and for correct operation of our turbines under all conditions.

Constant turbine speed, together with high efficiencies at all gateages, and with the turbines running under extreme varying heads of water, is essentially necessary for a thoroughly successful commercial installment. To illustrate: we call your especial attention to the following tables compiled from Holyoke tests, of three vertical turbines of different types running under widely varying heads of water from part gate to full gate, at a constant speed of 175 revolutions per minute.

These constant speed values are given in the tables on opposite page 5.

CONSTANT SPEED TABLES

HOLYOKE TEST No. 1892 VERTICAL 35 STANDARD SAMSON TURBINES.

Revolutions per Minute	Proportional Gateage	11 Ft. Head		14 Ft. Head		17 Ft. Head		20 Ft. Head	
		Efficiency	Horse Power	Efficiency	Horse Power	Efficiency	Horse Power	Efficiency	Horse Power
175	1.000	78.15	93.4	80.40	137.0	79.85	181.5	78.70	228.2
175	.970	79.90	93.4	81.75	136.6	81.17	180.8	79.80	226.8
175	.906	82.80	93.0	84.15	135.5	83.25	178.6	81.60	223.2
175	.800	78.30	75.2	87.48	128.2	85.90	168.5	83.70	208.8
175	.762	78.20	62.3	88.00	124.5	86.35	163.3	84.00	201.2
175	.700	78.20	59.4	85.00	109.2	86.85	153.3	84.20	188.7
175	.600	74.20	47.4	80.75	86.1	83.07	122.2	83.95	161.7

HOLYOKE TEST No. 2359 VERTICAL 35 TYPE F TURBINES.

Revolutions per Minute	Proportional Gateage	11 Ft. Head		14 Ft. Head		17 Ft. Head		20 Ft. Head	
		Efficiency	Horse Power	Efficiency	Horse Power	Efficiency	Horse Power	Efficiency	Horse Power
175	1.000	88.00	108.5	87.47	154.5	86.00	202.4	84.25	251.5
175	.889	89.30	99.6	91.08	147.6	88.60	190.6	86.30	234.5
175	.833	86.45	87.0	93.00	141.4	90.15	182.2	86.65	222.5
175	.778	84.85	80.1	90.80	127.5	90.10	172.4	86.70	210.0
175	.667	81.25	66.9	87.45	103.2	88.00	141.6	86.60	180.2
175	.556	76.00	49.5	83.45	80.1	84.83	112.2	84.35	142.3

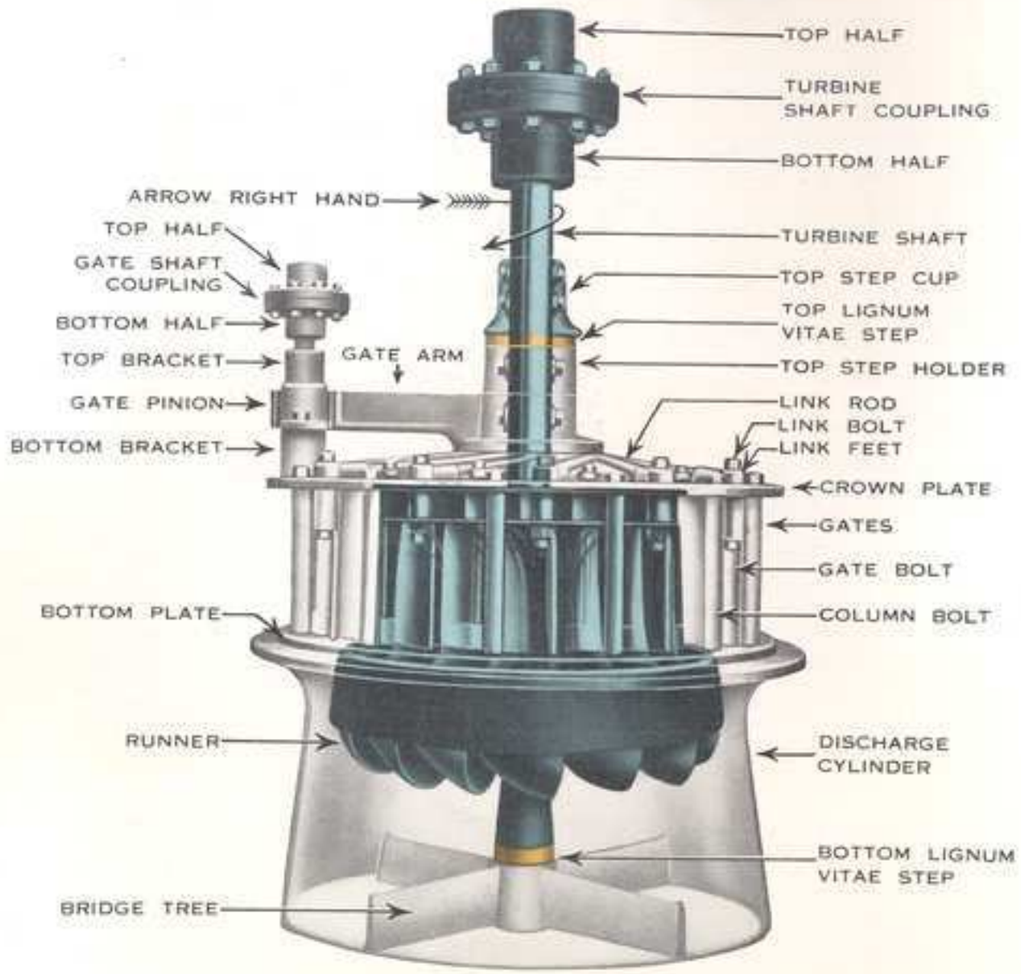
HOLYOKE TEST No. 2363, VERTICAL 30 TYPE Z TURBINES.

Revolutions per Minute	Proportional Gateage	11 Ft. Head		14 Ft. Head		17 Ft. Head		20 Ft. Head	
		Efficiency	Horse Power	Efficiency	Horse Power	Efficiency	Horse Power	Efficiency	Horse Power
175	1.000	83.50	162.3	83.35	227.5	81.40	288.0	79.30	348.0
175	.891	87.30	160.0	87.30	223.5	85.35	285.0	83.30	344.0
175	.796	88.35	148.7	90.00	215.5	87.90	273.0	85.85	330.5
175	.749	86.65	137.8	90.50	206.5	89.07	265.0	86.75	320.8
175	.700	84.20	127.0	89.55	192.5	89.28	252.0	87.00	305.0
175	.600	77.20	100.4	83.90	155.2	87.23	215.5	85.90	269.5
175	.500	70.90	77.8	77.20	121.0	80.65	168.0	81.60	217.5

We furnish blueprint curve tables showing guaranteed power, speed and efficiency values for any of our various turbines running constant speed, at different gateages, under variable heads. Also, blueprint copies of tests of our turbines tested at Holyoke and in place, together with blueprint drawing showing correct installament and operation of our turbines under all conditions and requirements.

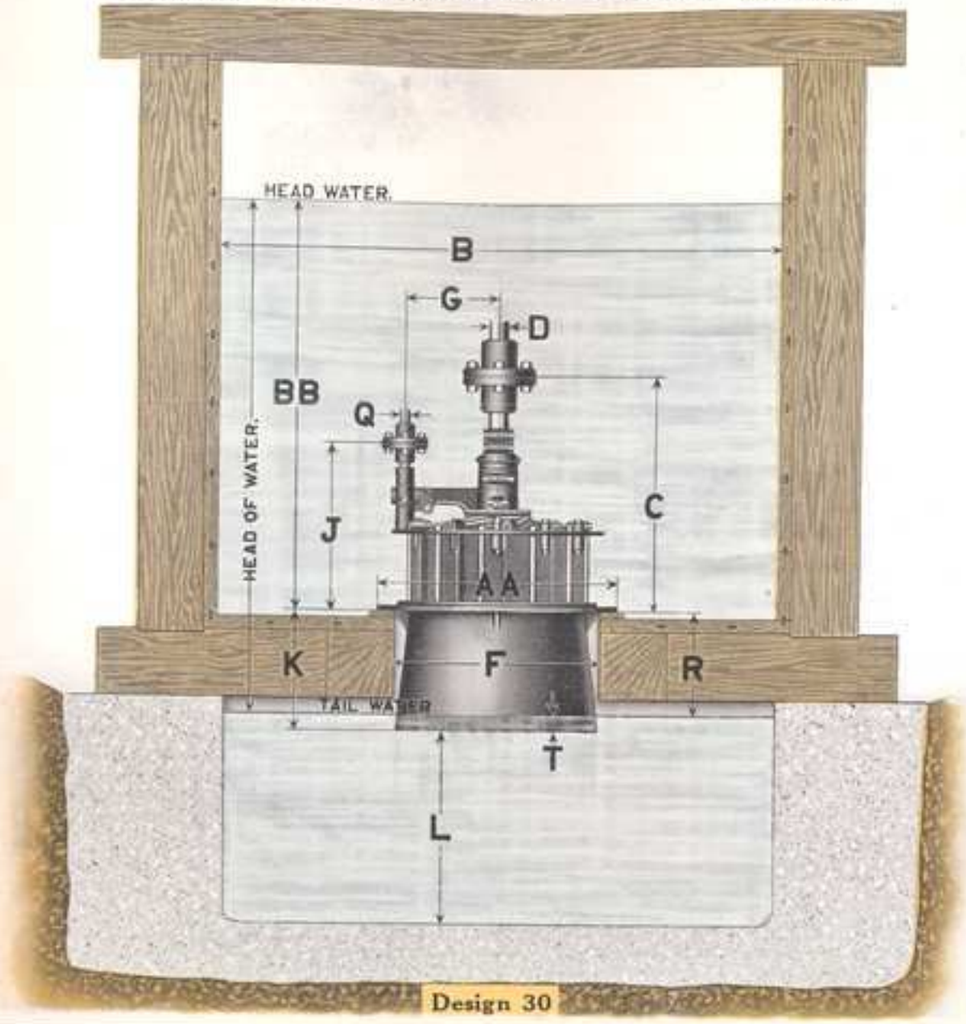
Vertical Standard Samson Turbines

These turbines are built strong and substantial, and equipped with our exclusive design double steel bucket runners fitted on steel shafts. Large top and bottom lignumvitae step bearings for carrying the revolving parts of these turbines, including the weight of extra upright shafting and gearing. Also, balanced swing-type gates with separate adjustable steel connections. Each gate removable independently. All bearings of large dimensions and special material. Bolted couplings.



NAMES of the different turbine parts given above.
All revolving parts of these turbines are colored BLUE.
Top and bottom lignumvitae step bearings colored YELLOW.
The arrow on turbine shaft shows turbine revolving RIGHT HAND.
Turbines revolving opposite to this arrow would revolve LEFT HAND.
We BORE and KEYSEAT the upper half turbine and gate shaft couplings.
POWER TABLES of these SAMSON turbines on pages 10 to 13, inclusive.
CONSTANT SPEED table these SAMSON turbines page 5, Holyoke Test No. 1892.
CORRECT installment dimensions of these turbines on opposite page 7.
We also build SPECIAL SAMSON, TYPE F, TYPE J, TYPE K turbines.
We furnish special particulars regarding these SPECIAL SAMSON turbines.
We also build these STANDARD and SPECIAL SAMSON turbines horizontal designs.

Dimensions of Vertical Standard Samson Turbines

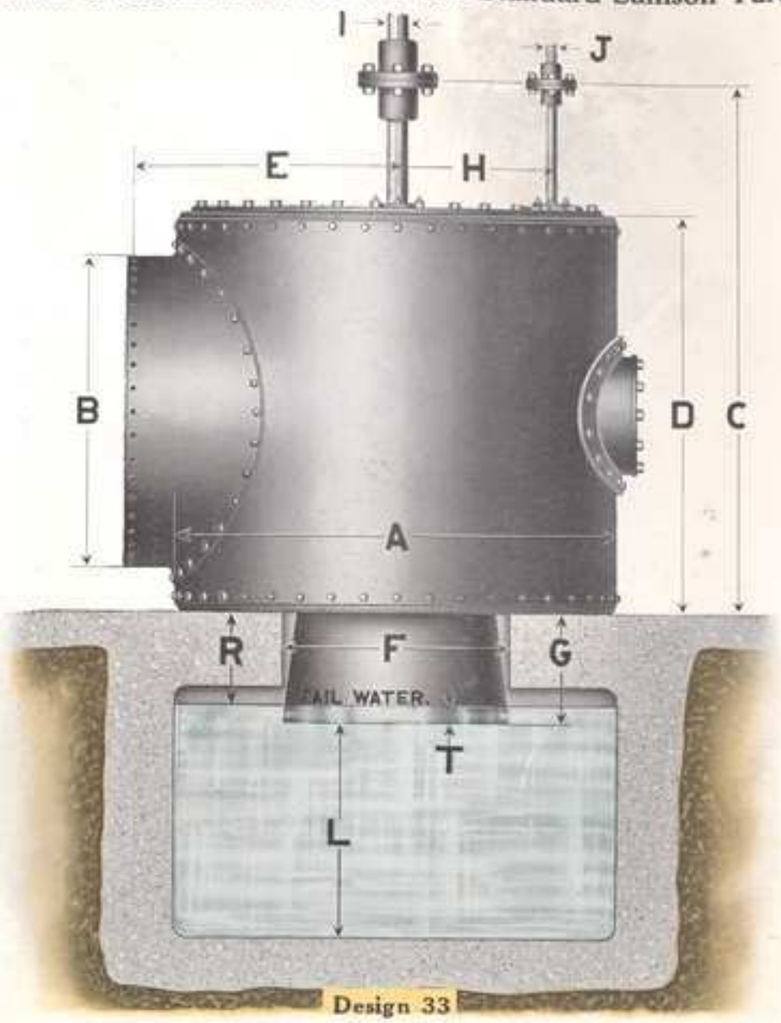


Design 30

SIZE OF SAMSON TURBINES		17E	17D	17C	17B	17A	20	23	26	30	35	40	45	50	56	62	68	74
AA	Cylinder Flange Diameter...	33	33	33	33	33	36	40	44	49	56	63	70	76	86	94	102	110
B	Penstock Width not less than	48	48	48	48	48	60	72	84	96	108	120	132	144	156	168	180	192
BB	Water Depth not less than ..	42	42	42	42	42	48	54	60	66	72	78	84	90	96	102	108	114
C	Turbine Shaft Height.....	32	32	32	32	32	35	40	45	50	55	60	65	70	75	80	85	90
D	Turbine Coupling Bore	2 1/8	2 3/8	2 3/8	2 5/8	2 5/8	2 7/8	3 1/8	3 3/8	3 5/8	4 3/8	4 7/8	5 3/8	5 7/8	6 3/8	6 7/8	7 3/8	7 7/8
F	Diameter Hole in Floor.....	28	28	28	28	28	31	35	39	44	51	57	64	70	78	86	94	102
G	Between Shaft Centers	12	12	12	12	12	14	16	18	20	22	25	28	31	34	38	42	46
J	Gate Shaft Height	23	23	23	23	23	25	27	29	32	35	38	42	46	50	54	59	64
K	Discharge Cylinder Length..	15	15	15	15	15	17	19	21	24	27	30	33	36	40	44	48	52
L	Discharge Depth not less than	27	27	27	27	27	30	36	42	48	54	60	66	72	84	96	108	120
Q	Gate Coupling Bore.....	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 7/16	1 7/16	1 11/16	1 11/16	1 15/16	1 15/16	2 3/16	2 3/16	2 7/16	2 7/16	2 11/16	2 11/16
T	Submergence not less than ..	3	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6

All dimensions in the above table are given in INCHES.
Power tables of these vertical SAMSON turbines on pages 10 to 13 inclusive.
We also build these SAMSON turbines various horizontal designs as required.
Dimensions of STEEL FLUMES for these vertical SAMSON turbines on page 8.

Dimension of Steel Flumes For Vertical Standard Samson Turbines

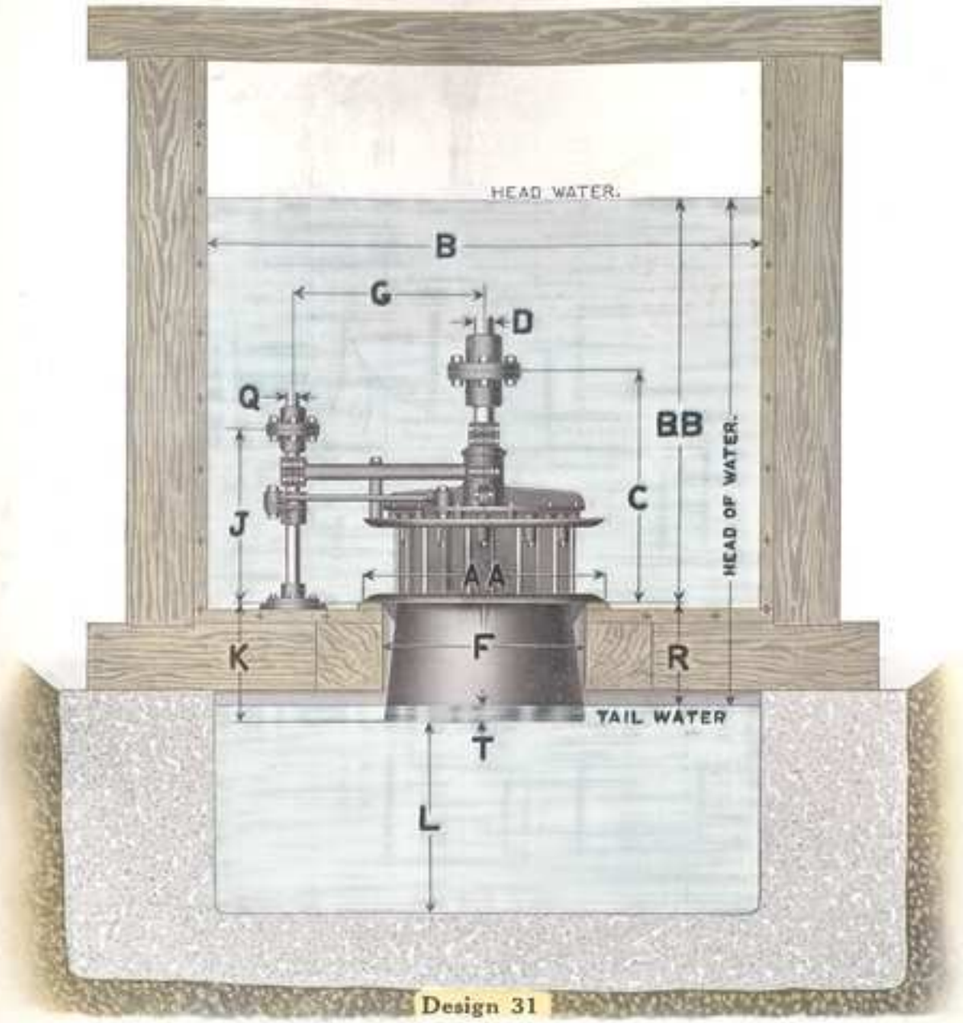


Design 33

	SIZE OF SAMSON TURBINES	17E	17D	17C	17B	17A	20	23	26	30	35	40	45	50	56
A	Diameter of Steel Flume	54	54	54	54	54	60	66	72	84	96	108	120	132	144
B	Inside Diameter of Feeder Pipe	24	26	28	30	36	42	48	54	60	72	84	96	108	120
C	Height of Turbine and Gate Shafts	54	56	58	60	66	72	78	84	90	102	114	132	144	156
D	Height of Steel Flume	36	38	40	42	48	54	60	66	72	84	96	108	120	132
E	Center Turbine Shaft to Center of Rivet Holes	33	33	33	33	33	36	39	42	48	54	60	66	72	78
F	Size of Hole to Clear Discharge Cylinder	28	28	28	28	28	31	35	39	44	51	57	64	70	78
G	Length of Discharge Cylinder under Flume	12	12	12	12	12	13	15	17	19	22	25	28	31	34
H	Distance Between Centers of Shafts	12	12	12	12	12	14	16	18	20	22	25	28	31	34
I	Diameter of Bore in Turbine Shaft Coupling	2 1/8	2 3/8	2 3/8	2 5/8	2 5/8	2 7/8	3 1/8	3 3/8	3 7/8	4 3/8	4 7/8	5 3/8	5 7/8	6 3/8
J	Diameter of Bore in Gate Shaft Coupling	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 7/16	1 7/16	1 11/16	1 11/16	1 15/16	1 15/16	2 3/16	2 3/16	2 7/16
L	Depth under Disch. Cylinder not less than	27	27	27	27	27	30	36	42	48	54	60	66	72	84
T	Submergence of Disch. Cylinder not less than	3	3	3	3	3	4	4	4	4	5	5	5	5	6

All dimensions in the above table are given in INCHES.
These STEEL FLUMES larger than 10 feet diameter made in sections, riveted together when placing to position. Top and bottom heads cast iron. We build all sizes vertical and horizontal steel flumes, pipes and draft tubes.

Special Vertical Samson Turbines with Top Gate Operating Ring



Design 31

We furnish our various types of vertical SAMSON turbines with different designs of connections for operating the gates. The above illustration shows our improved gate operating ring of simple design, strongly constructed, split and easily removable. The upright gate shaft rotates 45° or 60° for full gate movement, reducing to minimum friction and wear. These gates under water pressure are balanced design and so arranged that in case of breakage the gates will slowly close. Each gate can be removed separately. The revolving parts of these turbines are carried on large top and bottom lignumvitae step bearings. If required, we will bronze bush all the gate connection bearings. We also build our various types of vertical SAMSON turbines with gates of special design, also top and bottom plates with curved inlet edges, as illustrated above, which increases the power, speed and efficiency values. These SAMSON turbines built with special gate equipment and curved plates, we specify as our special TYPE F, TYPE J and TYPE K SAMSON turbines.

We also build these special SAMSON turbines horizontal design.

POWER TABLE—VERTICAL STANDARD SAMSON TURBINES.

Size of Turbine	Head	3	4	5	6	7	8	9	10	11	12	13	14
17 E.	Power	1.1	1.7	2.5	3.2	4.1	5.0	6.0	7.0	8.1	9.2	10.4	11.7
	Water	252	291	325	356	384	411	436	460	482	503	524	544
	Speed	161	186	208	228	246	264	280	294	308	322	335	348
17 D.	Power	1.5	2.3	3.2	4.3	5.4	6.5	7.8	9.2	10.6	12.0	13.6	15.2
	Water	328	379	423	464	502	536	569	601	629	657	683	709
	Speed	161	186	208	228	246	264	280	294	308	322	335	348
17 C.	Power	2.0	3.0	4.3	5.6	7.1	8.6	10.3	12.1	14.0	15.8	17.9	19.0
	Water	433	499	558	611	650	706	749	791	828	864	900	934
	Speed	161	186	208	228	246	264	280	294	308	322	335	348
17 B.	Power	2.4	3.7	5.3	7.0	8.7	10.6	12.7	14.9	17.2	19.5	22.0	24.7
	Water	533	616	689	754	815	871	924	975	1021	1066	1110	1153
	Speed	161	186	208	228	246	264	280	294	308	322	335	348
17 A.	Power	3.2	4.9	6.9	9.1	11.4	13.9	16.6	19.5	22.5	25.5	28.8	32.3
	Water	697	805	900	986	1065	1139	1208	1275	1335	1394	1451	1506
	Speed	161	186	208	228	246	264	280	294	308	322	336	348
20.	Power	4.2	6.4	9.0	11.9	15.0	18.3	21.8	25.5	29.5	33.6	37.8	42.3
	Water	914	1055	1180	1293	1396	1493	1583	1669	1750	1828	1903	1975
	Speed	140	162	182	199	215	230	244	257	270	282	293	304
23.	Power	5.5	8.5	11.9	15.7	19.8	24.2	28.8	33.8	39.0	44.4	50.0	55.9
	Water	1209	1391	1561	1710	1847	1974	2094	2207	2315	2418	2517	2612
	Speed	127	141	158	173	187	200	211	224	235	245	255	265
26.	Power	7.10	10.9	15.2	20.1	25.3	30.9	36.8	43.2	49.8	56.7	64.0	71.5
	Water	1545	1784	1995	2185	2360	2523	2676	2821	2959	3090	3216	3338
	Speed	108	125	140	153	166	177	188	198	207	217	226	234
30.	Power	9.44	14.5	20.3	26.7	33.6	41.1	49.1	57.5	66.3	75.5	85.2	95.2
	Water	2057	2375	2656	2909	3142	3359	3563	3756	3939	4114	4282	4444
	Speed	94	108	121	132	143	153	163	171	180	188	195	203
35.	Power	12.8	19.7	27.5	36.2	45.6	55.7	66.5	77.9	89.8	102.0	115.0	129.0
	Water	2789	3220	3600	3944	4260	4554	4830	5091	5339	5577	5805	6024
	Speed	81	93	104	114	123	132	140	147	154	161	168	174
40.	Power	16.8	25.8	36.1	47.5	59.8	73.1	87.2	102.0	118.0	134.0	151.0	169.0
	Water	3657	4223	4722	5172	5587	5972	6335	6677	7003	7315	7613	7900
	Speed	70	81	91	100	108	115	122	129	135	141	147	152
45.	Power	21.2	32.7	45.7	60.1	75.7	92.5	110.0	129.0	149.0	170.0	192.0	214.0
	Water	4629	5344	5975	6546	7070	7558	8017	8450	8861	9257	9635	9999
	Speed	63	72	81	88	96	102	109	114	120	125	130	135
50.	Power	26.2	40.5	56.4	74.2	93.5	114.0	136.0	160.0	184.0	210.0	235.0	264.0
	Water	5714	6598	7377	8081	8729	9331	9897	10433	10942	11429	11795	12341
	Speed	56	65	73	80	86	92	98	103	108	113	117	122
56.	Power	32.9	50.6	70.8	93.0	117.0	143.0	171.0	200.0	231.0	263.0	297.0	332.0
	Water	7168	8277	9254	10137	10950	11705	12415	13087	13726	14336	14922	15485
	Speed	50	58	65	71	77	82	87	92	96	101	105	109
62.	Power	40.3	62.1	86.8	114.0	144.0	176.0	210.0	245.0	283.0	323.0	364.0	407.0
	Water	8787	10156	11344	12426	13419	14349	15219	16042	16825	17574	18291	18982
	Speed	45	52	59	64	69	74	79	83	87	91	95	98
68.	Power	48.5	74.7	104.0	137.0	171.0	211.0	252.0	295.0	341.0	388.0	438.0	489.0
	Water	10570	12204	13645	14947	16145	17258	18306	19297	20238	21139	22002	22832
	Speed	41	48	53	59	63	68	72	76	79	83	86	89
74.	Power	57.5	88.5	124.0	162.0	205.0	250.0	299.0	350.0	403.0	460.0	518.0	579.0
	Water	12517	14453	16159	17701	19120	20439	21679	22852	23967	25034	26056	27039
	Speed	38	44	49	54	58	62	66	70	73	76	79	82

EXPLANATION OF ABOVE TABLES

HEAD — Effective head in feet. WATER — Cubic feet discharged per minute.
POWER — Full gate horsepower. SPEED — Number of revolutions per minute.

We also build STANDARD SAMSON turbines developing power and speed values HALF WAY between each of the different sizes of turbines given in above table.

These vertical STANDARD SAMSON turbines to develop above power, speed and efficiency values, must be installed and operated substantially as given on page 7.

POWER TABLE—VERTICAL STANDARD SAMSON TURBINES.

Size of Turbine	Head	15	16	17	18	19	20	21	22	23	24	25	26
17 E.	Power	12.9	14.3	15.6	17.0	18.4	19.9	21.4	22.9	24.5	26.2	27.8	29.5
	Water	553	581	599	617	634	650	666	682	697	712	727	741
	Speed	360	373	384	394	405	416	426	436	446	454	464	474
17 D.	Power	16.9	18.6	20.4	22.1	24.0	25.9	27.9	29.9	32.0	34.1	36.2	38.5
	Water	734	758	782	804	827	848	869	889	909	929	948	967
	Speed	360	373	384	394	405	416	426	436	446	454	464	474
17 C.	Power	22.2	24.5	26.8	29.1	31.6	34.1	36.8	39.4	42.2	45.0	47.7	50.7
	Water	967	998	1029	1059	1088	1116	1144	1171	1197	1223	1248	1273
	Speed	360	373	384	394	405	416	426	436	446	454	464	474
17 B.	Power	27.4	30.2	33.1	36.0	39.0	42.1	45.4	48.6	52.0	55.5	58.9	62.6
	Water	1193	1232	1270	1307	1343	1377	1411	1444	1476	1509	1540	1571
	Speed	360	372	384	394	405	416	426	436	446	454	464	474
17 A.	Power	35.6	39.5	43.3	47.0	51.0	55.0	59.3	63.5	68.0	72.5	77.0	81.8
	Water	1559	1610	1660	1708	1755	1800	1845	1888	1930	1972	2013	2053
	Speed	360	372	384	394	406	416	426	436	446	454	464	474
20.	Power	46.9	51.5	56.6	61.7	66.9	72.2	77.7	83.3	89.0	94.9	101.0	107.0
	Water	2044	2111	2179	2239	2300	2360	2419	2476	2531	2586	2639	2691
	Speed	315	325	335	345	354	364	373	381	390	398	407	415
23.	Power	62.0	68.3	74.9	81.6	88.5	95.5	103.0	110.0	118.0	126.0	133.0	141.0
	Water	2703	2792	2878	2961	3043	3122	3199	3274	3348	3420	3489	3559
	Speed	274	283	292	300	308	316	324	332	339	346	354	361
26.	Power	79.3	87.3	95.7	104.0	113.0	121.0	131.0	141.0	151.0	160.0	171.0	180.0
	Water	3455	3569	3678	3785	3888	3919	4088	4181	4278	4370	4460	4549
	Speed	242	250	258	265	273	280	287	293	300	306	313	319
30.	Power	106.0	116.0	127.0	139.0	150.0	162.0	175.0	188.0	200.0	214.0	227.0	241.0
	Water	4600	4751	4897	5039	5177	5312	5443	5571	5696	5818	5938	6056
	Speed	210	217	224	230	236	242	248	254	260	265	271	276
35.	Power	143.0	158.0	173.0	188.0	204.0	220.0	237.0	254.0	272.0	290.0	308.0	327.0
	Water	6236	6440	6638	6831	7018	7200	7378	7552	7721	7887	8050	8210
	Speed	180	186	192	197	203	208	213	218	223	227	232	237
40.	Power	188.0	207.0	226.0	247.0	268.0	289.0	311.0	333.0	356.0	380.0	404.0	428.0
	Water	8178	8446	8706	8958	9204	9443	9676	9904	10126	10344	10558	10767
	Speed	157	163	168	172	177	182	186	191	195	199	203	207
45.	Power	238.0	262.0	287.0	312.0	336.0	366.0	393.0	422.0	451.0	481.0	511.0	542.0
	Water	10350	10689	11018	11337	11648	11951	12246	12534	12816	13091	13361	13626
	Speed	140	145	149	153	158	162	166	170	173	177	181	184
50.	Power	293.0	324.0	354.0	385.0	418.0	451.0	486.0	521.0	557.0	593.0	631.0	669.0
	Water	12777	13196	13603	13997	14380	14754	15118	15474	15822	16162	16496	16822
	Speed	126	130	134	138	142	145	149	153	156	159	162	166
56.	Power	368.0	405.0	444.0	484.0	524.0	566.0	609.0	653.0	699.0	744.0	791.0	839.0
	Water	16028	16554	17063	17558	18039	18508	18965	19411	19847	20274	20692	21102
	Speed	112	116	120	123	127	130	133	136	139	142	145	148
62.	Power	451.0	497.0	544.0	593.0	643.0	694.0	747.0	801.0	856.0	913.0	970.0	1030.0
	Water	19648	20292	20917	21523	22113	22688	23248	23795	24329	24853	25365	25868
	Speed	102	105	108	111	114	117	120	123	126	128	131	134
68.	Power	542.0	597.0	654.0	713.0	773.0	835.0	898.0	963.0	1030.0	1098.0	1167.0	1238.0
	Water	23634	24409	25160	25890	26599	27290	27964	28622	29265	29895	30511	31115
	Speed	93	96	99	101	104	107	109	112	115	117	120	122
74.	Power	642.0	708.0	775.0	844.0	916.0	992.0	1064.0	1141.0	1220.0	1296.0	1382.0	1466.0
	Water	27888	28906	29796	30659	31500	32318	33116	33895	34657	35403	36132	36848
	Speed	85	88	91	94	96	99	101	103	106	108	110	112

EXPLANATION OF ABOVE TABLES

HEAD — Effective head in feet. WATER — Cubic feet discharged per minute.
POWER — Full gate horsepower. SPEED — Number of revolutions per minute.

We also build STANDARD SAMSON turbines developing power and speed values HALF WAY between each of the different sizes of turbines given in above table.

These vertical STANDARD SAMSON turbines to develop above power, speed and efficiency values, must be installed and operated substantially as given on page 7.

POWER TABLE—VERTICAL STANDARD SAMSON TURBINES.

Size of Turbine	Head	27	28	29	30	31	32	33	34	35	36	37	38
17 E.	Power	31.4	32.9	34.8	36.5	38.3	40.4	42.2	44.0	46.2	48.0	50.2	52.0
	Water	755	769	783	796	809	822	835	847	860	872	884	896
	Speed	463	492	501	510	518	526	534	542	550	557	564	573
17 D.	Power	41.0	42.9	45.4	47.6	49.0	52.8	55.1	57.5	60.3	62.6	65.5	67.8
	Water	935	1003	1021	1039	1056	1072	1089	1105	1121	1137	1153	1169
	Speed	463	492	501	510	518	526	534	542	550	557	564	573
17 C.	Power	53.9	56.4	59.7	62.6	65.7	69.4	72.5	75.6	79.4	82.5	86.2	89.3
	Water	1297	1321	1344	1367	1389	1412	1433	1454	1476	1497	1518	1538
	Speed	463	492	501	510	518	526	534	542	550	557	564	573
17 B.	Power	68.6	69.6	73.7	77.3	81.1	85.7	89.5	93.3	97.9	102.0	106.0	110.0
	Water	1600	1629	1659	1687	1714	1742	1769	1795	1821	1847	1873	1898
	Speed	484	492	501	510	518	526	534	542	550	557	564	573
17 A.	Power	87.0	91.0	96.3	101.0	106.0	112.0	117.0	122.0	128.0	133.0	139.0	144.0
	Water	2092	2130	2168	2205	2241	2277	2312	2347	2381	2415	2448	2481
	Speed	484	492	501	510	518	526	534	542	550	556	564	574
20.	Power	113.0	120.0	126.0	133.0	139.0	146.0	153.0	160.0	167.0	174.0	182.0	189.0
	Water	2742	2793	2842	2891	2939	2986	3032	3078	3127	3167	3210	3254
	Speed	423	430	438	445	453	460	467	474	481	488	495	501
23.	Power	150.0	158.0	167.0	175.0	184.0	193.0	202.0	212.0	221.0	231.0	240.0	250.0
	Water	3627	3694	3759	3823	3887	3949	4010	4070	4130	4188	4246	4303
	Speed	368	374	381	387	394	400	406	412	418	424	430	436
26.	Power	191.0	202.0	213.0	224.0	236.0	247.0	259.0	271.0	283.0	295.0	307.0	320.0
	Water	4635	4720	4804	4886	4967	5046	5125	5202	5278	5352	5426	5499
	Speed	325	331	337	343	348	354	359	365	370	375	380	386
30.	Power	255.0	269.0	284.0	299.0	314.0	329.0	344.0	360.0	376.0	393.0	409.0	426.0
	Water	6171	6285	6396	6505	6613	6718	6823	6925	7026	7126	7224	7321
	Speed	282	287	292	297	302	307	311	316	321	325	330	334
35.	Power	348.0	364.0	385.0	405.0	425.0	446.0	467.0	488.0	510.0	532.0	554.0	577.0
	Water	8366	8520	8670	8818	8964	9108	9249	9388	9525	9660	9793	9925
	Speed	242	246	250	255	259	263	267	271	275	278	282	287
40.	Power	453.0	479.0	506.0	531.0	558.0	585.0	612.0	640.0	668.0	698.0	727.0	757.0
	Water	10972	11173	11371	11565	11756	11944	12130	12312	12472	12669	12844	13016
	Speed	211	215	219	223	226	230	234	237	240	244	247	251
45.	Power	574.0	606.0	638.0	672.0	708.0	740.0	775.0	811.0	847.0	883.0	920.0	958.0
	Water	13886	14140	14390	14636	14879	15116	15351	15582	15809	16034	16255	16473
	Speed	188	191	195	198	201	205	208	211	214	217	220	223
50.	Power	708.0	748.0	788.0	829.0	871.0	914.0	957.0	1000.0	1045.0	1090.0	1136.0	1184.0
	Water	17143	17458	17766	18070	18369	18662	18952	19237	19518	19795	20068	20337
	Speed	169	172	175	178	181	184	187	190	192	195	198	201
56.	Power	888.0	938.0	989.0	1040.0	1093.0	1146.0	1200.0	1256.0	1314.0	1368.0	1426.0	1483.0
	Water	21504	21900	22286	22667	23042	23410	23780	24142	24506	24850	25200	25530
	Speed	150	153	156	159	162	164	167	169	172	174	176	179
62.	Power	1039.0	1150.0	1212.0	1275.0	1340.0	1408.0	1470.0	1538.0	1608.0	1675.0	1745.0	1818.0
	Water	26360	26838	27309	27786	23246	28698	29163	29623	30092	30450	30880	31300
	Speed	136	139	141	144	146	148	150	153	155	157	160	162
68.	Power	1310.0	1380.0	1457.0	1534.0	1610.0	1688.0	1768.0	1847.0	1932.0	2018.0	2100.0	2186.0
	Water	31708	32290	32874	33450	33983	34516	35046	35572	36120	36620	37150	37650
	Speed	124	127	129	131	134	136	138	140	142	144	146	148
74.	Power	1551.0	1640.0	1728.0	1818.0	1910.0	2005.0	2095.0	2193.0	2292.0	2390.0	2490.0	2591.0
	Water	37550	38240	38900	39560	40220	40878	41540	42150	42750	43300	43950	44500
	Speed	114	116	118	120	122	124	126	128	130	132	134	136

EXPLANATION OF ABOVE TABLES

HEAD — Effective head in feet. WATER — Cubic feet discharged per minute.
POWER — Full gate horsepower. SPEED — Number of revolutions per minute.

We also build STANDARD SAMSON turbines developing power and speed values HALF WAY between each of the different sizes of turbines given in above table.

These vertical STANDARD SAMSON turbines to develop above power, speed and efficiency values, must be installed and operated substantially as given on page 7.

POWER TABLE—VERTICAL STANDARD SAMSON TURBINES.

Size of Turbine	Head	39	40	41	42	43	44	45	46	47	48	49	50
17 E.	Power	54.2	56.3	58.5	60.6	62.8	65.0	67.0	69.0	71.0	73.6	76.0	78.0
	Water	908	919	930	942	953	964	974	984	995	1006	1016	1026
	Speed	581	588	596	603	610	616	623	630	637	644	650	657
17 D.	Power	70.7	73.5	76.3	79.1	82.0	84.8	87.0	90.0	93.0	96.0	99.0	102.0
	Water	1184	1199	1214	1229	1243	1257	1270	1284	1297	1314	1325	1333
	Speed	581	588	596	603	610	616	623	630	637	644	650	657
17 C.	Power	93.0	96.7	100.0	104.0	108.0	112.0	115.0	119.0	123.0	126.0	131.0	135.0
	Water	1559	1579	1598	1618	1637	1655	1673	1691	1710	1728	1746	1763
	Speed	581	588	596	603	610	616	623	630	637	644	650	657
17 B.	Power	115.0	119.0	124.0	128.0	133.0	138.0	142.0	147.0	152.0	156.0	162.0	167.0
	Water	1923	1948	1971	1995	2020	2042	2068	2090	2110	2132	2158	2179
	Speed	581	588	596	603	610	616	623	630	637	644	650	657
17 A.	Power	150.0	156.0	162.0	168.0	174.0	180.0	186.0	192.0	198.0	204.0	211.0	218.0
	Water	2514	2546	2577	2609	2640	2669	2700	2730	2760	2789	2818	2846
	Speed	582	588	596	602	610	616	623	630	637	644	650	657
20.	Power	197.0	204.0	212.0	220.0	228.0	236.0	244.0	252.0	260.0	268.0	277.0	285.0
	Water	3296	3338	3380	3420	3461	3500	3540	3579	3618	3656	3694	3731
	Speed	508	514	521	527	533	539	545	551	557	564	569	575
23.	Power	260.0	270.0	280.0	291.0	301.0	312.0	322.0	333.0	344.0	355.0	366.0	377.0
	Water	4359	4415	4470	4524	4577	4630	4683	4734	4785	4830	4886	4935
	Speed	442	447	453	458	463	469	474	480	485	490	495	500
26.	Power	332.0	345.0	359.0	372.0	385.0	398.0	417.0	426.0	440.0	453.0	468.0	482.0
	Water	5571	5642	5712	5781	5850	5917	5984	6050	6115	6180	6244	6306
	Speed	391	396	400	405	410	415	419	424	429	434	438	442
30.	Power	443.0	460.0	477.0	495.0	512.0	530.0	548.0	567.0	585.0	604.0	623.0	642.0
	Water	7417	7512	7605	7697	7788	7878	7967	8054	8142	8228	8314	8400
	Speed	339	343	347	351	356	360	364	367	372	376	379	381
35.	Power	600.0	623.0	647.0	670.0	695.0	719.0	743.0	768.0	792.0	819.0	845.0	871.0
	Water	10055	10183	10309	10434	10558	10677	10800	10919	11037	11160	11280	11385
	Speed	291	294	298	301	305	308	312	315	318	322	325	329
40.	Power	787.0	817.0	848.0	879.0	911.0	944.0	975.0	1008.0	1041.0	1075.0	1109.0	1143.0
	Water	13186	13354	13520	13684	13846	14006	14165	14315	14475	14625	14780	14930
	Speed	254	257	260	263	266	270	273	276	279	282	285	288
45.	Power	996.0	1034.0	1072.0	1115.0	1155.0	1196.0	1238.0	1278.0	1320.0	1362.0	1405.0	1448.0
	Water	16680	16901	17118	17320	17520	17720	17920	18120	18320	18520	18710	18900
	Speed	226	229	232	235	238	240	243	246	248	251	254	256
50.	Power	1232.0	1280.0	1330.0	1378.0	1427.0	1478.0	1527.0	1579.0	1630.0	1683.0	1736.0	1789.0
	Water	20600	20870	21120	21390	21640	21890	22140	22390	22610	22650	23100	23330
	Speed	203	205	208	211	213	215	218	220	223	225	227	230
56.	Power	1543.0	1602.0	1662.0	1725.0	1787.0	1849.0	1912.0	1976.0	2040.0	2105.0	2172.0	2239.0
	Water	25860	26200	26520	26820	27150	27470	27780	28090	28400	28700	29000	29260
	Speed	181	183	186	188	190	192	195	197	199	201	203	205
62.	Power	1890.0	1963.0	2035.0	2110.0	2186.0	2266.0	2340.0	2420.0	2500.0	2579.0	2660.0	2743.0
	Water	31700	32100	32500	32900	33280	33650	34050	34410	34800	35180	35520	35900
	Speed	164	166	168	170	172	174	176	178	180	182	184	186
68.	Power	2272.0	2361.0	2450.0	2540.0	2632.0	2725.0	2818.0	2912.0	3008.0	3105.0	3200.0	3300.0
	Water	38150	38620	39100	39580	40050	40500	40950	41400	41850	42300	42750	43200
	Speed	150	152	154	156	157	159	161	163	165	166	168	170
74.	Power	2692.0	2800.0	2908.0	3012.0	3120.0	3232.0	3340.0	3452.0	3565.0	3680.0	3795.0	3912.0
	Water	45100	45700	46250	46800	47350	47900	48450	49000	49500	50050	50550	51100
	Speed	137	139	141	143	144	146	148	149	151	152	154	156

EXPLANATION OF ABOVE TABLES

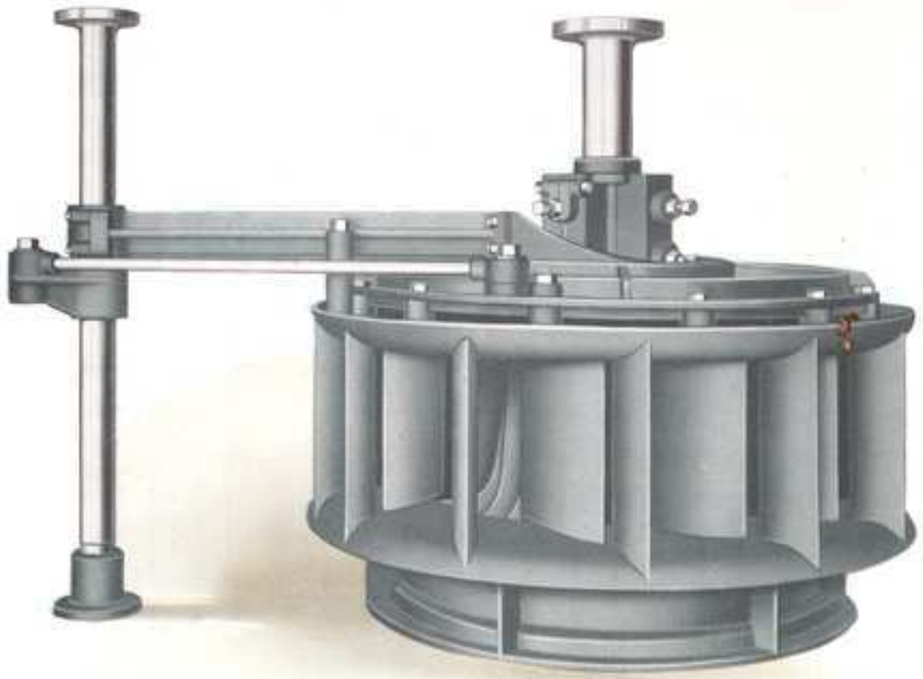
HEAD — Effective head in feet. WATER — Cubic feet discharged per minute.
POWER — Full gate horsepower. SPEED — Number of revolutions per minute.

We also build STANDARD SAMSON turbines developing power and speed values HALF WAY between each of the different sizes of turbines given in above table.

These vertical STANDARD SAMSON turbines to develop above power, speed and efficiency values, must be installed and operated substantially as given on page 7.

Vertical Type Z Turbines

These turbines are designed especially to develop highest power, speed and efficiencies for direct connection to generators and other high-speed machinery. These turbines are equipped with our latest type of single bucket runners of the strongest construction and fitted with special steel shafts. The gate casings are built with our improved balanced gates each separately removable. These gates connected to gate operating ring located in most accessible position on top of crown plate. This gate ring direct connected to vertical gate shaft which rotates 45° or 60° for full gate movement. The speed or guide vane ring guides the water into the gates, increasing the efficiency and securely holding the crown plates to position. The weight of the revolving parts of these vertical turbines must be carried on suitable anti-friction thrust bearings, roller or disk types running in oil and furnished in connection with the driven machines which are located on power house floor.



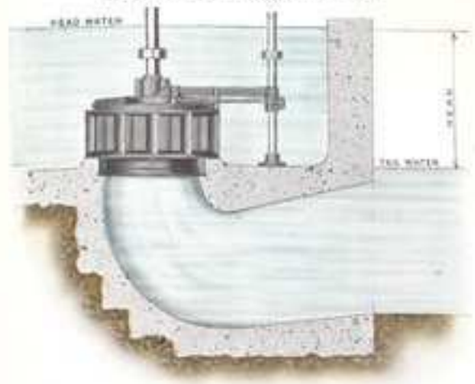
We also build these vertical TYPE Z turbines with gate operating ring located below the gates and direct connected to vertical gate shaft like illustration page 19. Located on the top of crown plate is large split removable lignumvitae pedestal bearing fitted with bronze adjusting bolts for holding turbine shaft in vertical alignment. We frequently bronze bush the gate casing bearings and construct gates and connections of steel.

GUARANTEE

We guarantee the full power, speed and efficiency values of these vertical Type Z turbines as given in power tables on pages 16 to 18, inclusive, when installed and operated in correctly designed penstocks and draft tubes in accordance with our drawings and specifications for same, substantially as illustrated on opposite page 15.

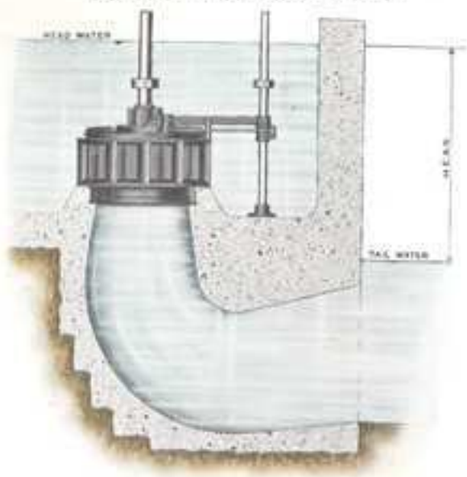
Correct Installment For Vertical Type Z Turbines

Low Head Installments



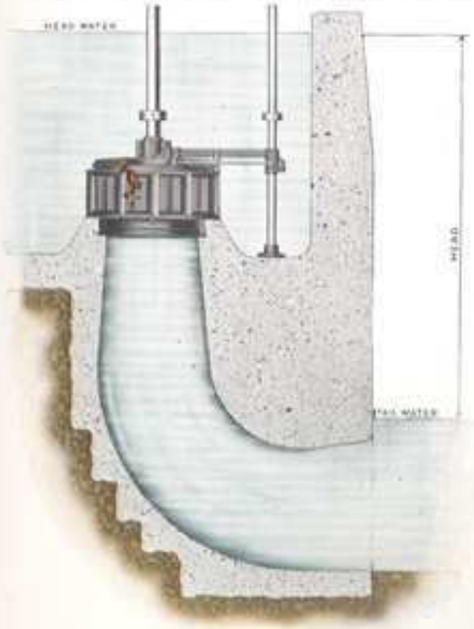
Design 75

Medium Head Installments



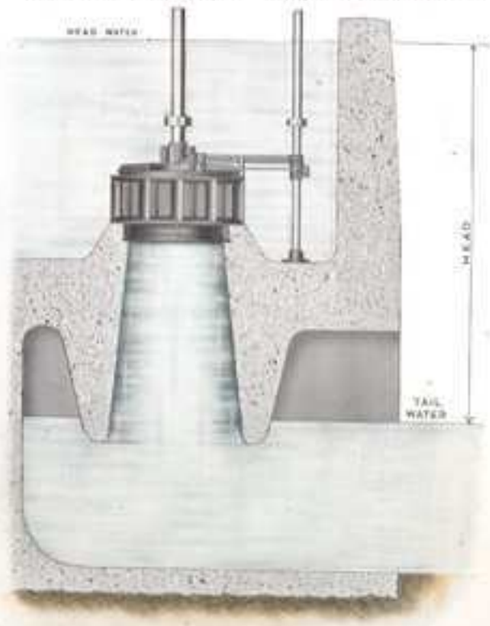
Design 76

Medium and High Head Installments



Design 77

Medium and High Head Installments



Design 78

Our vertical TYPE Z turbines to develop the power, speed and efficiency values given in power tables, pages 16 to 18, inclusive, must be installed and operated as illustrated above and in accordance with our plans and specifications, in correctly designed penstocks and draft tubes. Also, the weight of all revolving parts of complete unit must be carried by suitable thrust bearing, usually roller or disk type running in oil.

If these turbines are installed differently than shown above, or if built horizontally, we will furnish special curve tables showing power, speed and efficiency values that we would guarantee for same.

POWER TABLE—VERTICAL TYPE Z TURBINES.

Size of Turbine	Head	6	7	8	9	10	11	12	13	14	15	16	17
12.	Power	9.05	11.53	14.30	17.15	20.40	23.50	26.90	30.50	34.25	38.15	42.20	46.20
	Water	1035	1120	1202	1278	1352	1420	1487	1551	1613	1670	1730	1782
	Speed	306.0	331.0	354.0	375.0	395.0	415.0	432.5	450.0	467.0	484.0	500.0	515.0
15.	Power	14.47	18.24	22.50	27.05	31.85	37.20	42.50	48.20	54.10	60.20	68.70	72.90
	Water	1625	1755	1885	2006	2115	2225	2330	2432	2530	2620	2710	2795
	Speed	245.0	265.0	283.0	300.0	316.0	332.0	346.0	360.0	374.0	387.0	400.0	412.0
18.	Power	21.08	26.70	32.80	39.40	46.40	54.00	61.80	70.20	78.90	87.50	96.80	106.0
	Water	2350	2550	2725	2900	3060	3220	3370	3520	3665	3785	3925	4045
	Speed	204.0	221.0	236.0	250.0	263.0	276.0	288.0	300.0	312.0	323.0	333.0	343.0
21.	Power	29.05	36.72	45.30	54.50	63.90	74.50	85.50	96.80	108.9	121.0	133.9	146.6
	Water	3225	3485	3740	3980	4190	4425	4630	4830	5020	5200	5380	5550
	Speed	175.0	189.1	202.0	214.0	225.5	237.0	247.0	257.0	267.0	277.0	286.0	294.0
24.	Power	38.35	48.50	60.00	71.90	84.50	98.50	112.90	127.9	143.5	160.0	176.8	193.5
	Water	4230	4580	4920	5225	5510	5810	6075	6340	6590	6835	7070	7280
	Speed	153.0	165.5	177.0	187.5	197.5	207.5	216.0	225.0	234.0	242.0	250.0	257.5
27.	Power	49.25	62.00	76.60	91.80	108.1	126.0	144.3	163.5	183.6	204.5	226.5	247.5
	Water	5375	5825	6250	6650	7000	7385	7730	8060	8380	8700	8980	9250
	Speed	136.0	147.0	157.0	166.8	175.6	184.5	192.0	200.0	208.0	215.0	222.0	229.0
30.	Power	61.40	77.50	95.70	114.9	135.0	157.2	180.4	204.6	229.5	255.5	282.7	310.0
	Water	6680	7230	7760	8250	8700	9165	9600	10015	10415	10790	11150	11500
	Speed	122.5	132.2	141.4	150.0	158.1	165.8	173.2	180.2	187.0	193.6	200.0	206.0
33.	Power	74.25	93.55	115.2	138.2	163.2	190.5	217.5	246.5	276.5	308.0	342.0	375.0
	Water	8050	8720	9350	9940	10500	11100	11570	12080	12570	13000	13430	13900
	Speed	111.3	120.5	128.5	136.2	143.5	151.0	157.2	163.5	170.0	176.0	181.8	187.0
36.	Power	88.15	111.9	138.0	165.5	195.0	226.5	260.0	294.0	330.0	367.5	407.0	446.0
	Water	9610	10420	11180	11890	12560	13200	13810	14400	14990	15510	16040	16560
	Speed	102.0	110.5	118.0	125.0	131.5	138.0	144.0	150.0	156.0	161.0	166.5	171.5
39.	Power	103.7	131.0	162.0	194.2	228.3	266.0	304.5	345.5	388.0	431.5	477.5	524.0
	Water	11290	12210	13110	13950	14700	15500	16200	16920	17600	18200	18830	19420
	Speed	94.0	102.0	109.0	115.5	121.5	127.7	133.0	138.4	143.9	148.9	153.8	158.4
42.	Power	120.1	152.0	187.7	225.3	265.0	308.0	353.5	400.0	450.0	500.0	554.5	607.5
	Water	13100	14170	15210	16190	17050	17960	18800	19610	20440	21130	21850	22550
	Speed	87.5	94.5	101.0	107.0	113.0	118.5	123.5	128.5	133.5	138.5	143.0	147.0
45.	Power	138.0	174.5	215.3	258.0	304.0	354.0	406.0	459.5	517.0	575.0	636.0	697.0
	Water	15030	16270	17450	18550	19570	20610	21600	22510	23460	24270	25100	25880
	Speed	81.5	88.3	94.2	100.0	105.4	110.6	115.4	120.0	124.5	129.0	133.2	137.3
48.	Power	157.0	199.2	245.0	293.8	346.0	403.0	461.0	522.0	587.5	654.0	724.0	793.0
	Water	17100	18515	19860	21120	22300	23480	24560	25600	26650	27600	28530	29440
	Speed	76.5	82.7	88.4	93.6	98.7	103.6	108.0	112.5	117.0	121.0	125.0	129.0
51.	Power	176.5	224.0	276.5	332.0	391.0	455.0	521.5	590.0	663.0	738.0	816.5	895.0
	Water	19300	20900	22410	23870	25150	26500	27730	28920	30120	31160	32200	33200
	Speed	72.0	78.0	83.2	88.2	93.0	97.6	101.8	106.0	110.0	114.0	117.5	121.0
54.	Power	198.0	251.3	310.0	372.0	438.0	510.0	584.0	660.0	743.0	827.5	916.0	1003.0
	Water	21640	23430	25120	26730	28200	29700	31060	32400	33760	34930	36100	37250
	Speed	68.0	73.6	78.5	83.3	87.8	92.2	96.0	100.0	104.0	107.5	111.0	114.5
57.	Power	220.6	280.0	345.2	414.0	488.0	568.0	651.0	736.5	828.0	921.0	1020.0	1120.0
	Water	24110	26120	28000	29750	31400	33100	34630	36120	37600	38900	40230	41500
	Speed	64.5	69.6	74.5	79.0	83.0	87.3	91.0	94.6	98.4	101.7	105.0	108.5
60.	Power	244.5	310.0	383.0	459.0	541.0	629.0	721.0	817.0	918.5	1020.0	1131.0	1240.0
	Water	26730	28920	31040	33000	34800	36670	38380	40060	41700	43125	44600	46000
	Speed	61.2	66.2	70.7	75.0	79.0	83.0	86.5	90.0	93.5	96.7	100.0	103.0

EXPLANATION OF ABOVE TABLES

HEAD = Effective head in feet. WATER = Cubic feet discharged per minute.
POWER = Full gate horsepower. SPEED = Number of revolutions per minute.

These vertical TYPE Z turbines to develop above power, speed and efficiency values, must be installed and operated substantially as given on page 15.

We also build these TYPE Z turbines developing different power and speed values than given in above tables, for which we will furnish special particulars.

POWER TABLE—VERTICAL TYPE Z TURBINES.

Size of Turbine	Head	18	19	20	21	22	23	24	25	26	27	28	29
12.	Power	50.35	54.50	58.90	63.40	67.90	72.60	77.40	82.30	87.25	92.40	97.60	102.9
	Water	1834	1883	1933	1980	2026	2072	2118	2160	2205	2245	2290	2328
	Speed	530.0	545.0	559.0	572.5	587.0	600.0	612.0	625.0	637.0	650.0	662.0	674.0
15.	Power	79.60	86.00	93.00	100.0	107.4	114.5	122.2	130.0	137.6	146.0	154.8	162.3
	Water	2875	2950	3030	3105	3180	3250	3320	3390	3453	3520	3586	3650
	Speed	424.0	436.0	447.0	458.0	470.0	480.0	490.0	500.0	510.0	520.0	530.0	539.0
18.	Power	115.8	125.2	135.0	145.5	156.0	166.8	177.7	189.5	200.5	212.5	224.5	236.3
	Water	4165	4275	4385	4490	4600	4700	4800	4910	5000	5100	5190	5285
	Speed	353.0	363.0	372.0	382.0	392.0	400.0	408.0	417.0	425.0	433.0	441.0	449.0
21.	Power	159.5	173.0	187.0	201.0	215.5	230.0	245.5	261.5	276.8	293.0	309.5	326.2
	Water	5705	5865	6015	6160	6310	6450	6590	6730	6855	6985	7120	7245
	Speed	303.0	311.5	319.0	327.0	336.0	343.0	350.0	357.0	364.0	371.0	378.5	385.0
24.	Power	211.0	228.6	247.0	265.3	284.5	303.5	324.0	345.0	366.0	387.2	409.0	431.0
	Water	7490	7700	7900	8095	8285	8460	8650	8840	9010	9175	9350	9510
	Speed	265.0	272.5	279.0	286.0	294.0	300.0	306.0	312.5	318.5	325.0	331.0	337.0
27.	Power	269.5	292.0	316.0	340.0	364.5	390.0	414.0	442.2	468.0	497.0	523.0	552.0
	Water	9520	9780	10040	10300	10540	10775	10990	11225	11450	11670	11890	12100
	Speed	235.5	242.0	248.5	254.4	261.0	267.0	272.0	278.0	283.0	289.0	294.5	299.5
30.	Power	337.5	375.2	395.4	424.0	455.0	486.5	517.5	551.5	585.0	620.0	653.0	690.0
	Water	11830	12150	12500	12800	13080	13380	13650	13960	14230	14500	14760	15050
	Speed	212.0	218.0	223.5	229.0	235.0	240.0	245.0	250.0	255.0	260.0	265.0	269.5
33.	Power	408.0	443.0	479.0	514.0	551.0	589.0	628.0	670.0	710.0	750.0	792.0	835.0
	Water	14300	14700	15110	15500	15800	16190	16500	16900	17200	17550	17850	18200
	Speed	192.5	198.0	203.0	208.0	213.5	218.0	222.5	227.0	232.0	236.5	241.0	245.0
36.	Power	485.5	527.0	570.0	612.0	656.0	701.0	747.5	796.0	844.0	893.0	943.0	993.0
	Water	17030	17500	18000	18410	18810	19250	19650	20100	20480	20880	21230	21680
	Speed	176.5	181.5	186.0	191.0	196.0	200.0	204.0	208.0	212.5	217.0	221.0	224.5
39.	Power	570.0	618.0	669.0	718.0	770.0	822.7	877.0	935.0	990.0	1050.0	1107.0	1166.0
	Water	20000	20520	21110	21650	22100	22600	23080	23600	24050	24500	24930	25410
	Speed	163.0	167.5	172.0	176.0	180.8	184.5	188.4	192.2	196.0	200.0	204.0	207.0
42.	Power	661.0	717.0	776.0	833.0	894.0	954.0	1017.0	1085.0	1150.0	1215.0	1283.0	1353.0
	Water	23200	23800	24500	25100	25600	26200	26750	27350	27900	28400	28910	29490
	Speed	151.5	155.5	159.5	163.5	168.0	171.0	175.0	178.5	182.0	185.5	189.0	192.5
45.	Power	760.0	824.0	890.0	956.0	1025.0	1095.0	1168.0	1245.0	1320.0	1395.0	1474.0	1553.0
	Water	26600	27330	28100	28800	29400	30100	30700	31400	32000	32600	33200	33850
	Speed	141.3	145.4	149.0	152.6	156.5	160.0	163.0	166.5	170.0	173.3	176.5	179.5
48.	Power	864.0	936.0	1013.0	1088.0	1167.0	1247.0	1328.0	1417.0	1500.0	1587.0	1676.0	1767.0
	Water	30300	31100	32000	32760	33470	34250	34950	35720	36420	37120	37800	38500
	Speed	132.5	136.0	139.5	143.0	147.0	150.0	153.0	156.0	159.0	162.5	165.5	168.3
51.	Power	975.0	1058.0	1144.0	1230.0	1318.0	1408.0	1500.0	1600.0	1694.0	1790.0	1891.0	1995.0
	Water	34150	35050	36100	37000	37760	38660	39400	40290	41100	41850	42600	43450
	Speed	125.0	128.0	131.5	134.6	138.0	141.0	144.0	147.0	150.0	153.0	156.0	158.5
54.	Power	1093.0	1185.0	1283.0	1377.0	1477.0	1577.0	1682.0	1792.0	1898.0	2009.0	2122.0	2236.0
	Water	38350	39350	40450	41450	42350	43350	44200	45250	46100	46950	47750	48750
	Speed	117.8	121.0	124.0	127.0	130.5	133.0	136.0	139.0	141.5	144.5	147.0	149.5
57.	Power	1219.0	1320.0	1430.0	1535.0	1646.0	1760.0	1873.0	1998.0	2117.0	2240.0	2368.0	2490.0
	Water	42700	43830	45150	46200	47200	48250	49250	50360	51380	52300	53250	54300
	Speed	111.5	114.6	117.6	120.5	123.6	126.0	129.0	131.5	134.0	137.0	139.0	142.0
60.	Power	1350.0	1465.0	1584.0	1700.0	1824.0	1948.0	2078.0	2212.0	2344.0	2480.0	2620.0	2660.0
	Water	47320	48600	50000	51200	52320	53520	54600	55840	56920	58000	59040	60200
	Speed	106.0	109.0	111.7	114.5	117.5	120.0	122.5	125.0	127.5	130.0	132.5	134.7

EXPLANATION OF ABOVE TABLES

HEAD = Effective head in feet. WATER = Cubic feet discharged per minute.
POWER = Full gate horsepower. SPEED = Number of revolutions per minute.

These vertical TYPE Z turbines to develop above power, speed and efficiency values, must be installed and operated substantially as given on page 15.

We also build these TYPE Z turbines developing different power and speed values than given in above tables, for which we will furnish special particulars.

POWER TABLE—VERTICAL TYPE Z TURBINES.

Size of Turbine	Head	30	31	32	33	34	35	36	37	38	39	40	41
12.	Power	108.2	113.8	119.3	124.8	130.6	136.2	142.1	148.3	154.5	160.5	166.5	173.0
	Water	2368	2406	2445	2480	2520	2557	2590	2630	2665	2700	2730	2765
	Speed	685.0	695.5	707.0	717.0	730.0	740.0	750.0	760.0	771.0	782.5	790.0	800.0
15.	Power	171.0	179.0	188.5	197.0	206.2	215.5	224.5	234.0	244.0	253.0	263.0	273.5
	Water	3710	3770	3835	3890	3955	4015	4070	4120	4180	4235	4280	4340
	Speed	548.0	557.0	566.0	574.0	584.0	592.0	600.0	608.0	617.0	626.0	632.0	640.0
18.	Power	249.0	262.0	274.5	288.0	301.5	314.0	327.0	341.0	355.0	368.5	383.0	398.0
	Water	5375	5463	5550	5640	5725	5805	5890	5970	6050	6125	6200	6285
	Speed	456.0	464.0	471.0	478.0	486.0	493.0	500.0	506.0	514.0	521.0	526.0	533.0
21.	Power	343.0	360.0	378.0	396.5	414.0	433.0	451.5	470.0	490.0	509.0	528.0	549.0
	Water	7370	7495	7610	7725	7850	7965	8075	8180	8300	8405	8505	8610
	Speed	391.0	398.0	404.0	410.0	417.0	423.0	428.5	434.0	440.5	447.0	452.0	457.0
24.	Power	454.0	477.0	500.0	524.0	547.0	571.5	596.0	622.0	646.0	672.0	698.0	724.0
	Water	9680	9840	9990	10150	10300	10460	10600	10750	10890	11040	11170	11300
	Speed	342.0	348.0	354.0	358.5	365.0	370.0	375.0	380.0	386.0	391.0	395.0	400.0
27.	Power	580.0	610.0	640.0	670.5	700.0	732.0	761.0	794.0	827.0	860.0	893.0	927.0
	Water	12300	12500	12700	12900	13100	13300	13460	13650	13850	14015	14200	14380
	Speed	304.5	309.5	314.5	319.0	324.5	329.0	333.0	338.0	343.0	348.0	351.0	356.0
30.	Power	725.0	761.0	800.0	838.0	874.0	912.5	951.0	993.0	1033.0	1074.0	1116.0	1158.0
	Water	15295	15540	15800	16050	16280	16500	16740	16980	17200	17420	17640	17850
	Speed	274.0	278.5	283.0	287.0	292.0	296.0	300.0	304.0	308.0	312.0	316.0	320.0
33.	Power	879.0	923.0	967.5	1014.0	1060.0	1108.0	1153.0	1205.0	1253.0	1300.0	1355.0	1400.0
	Water	18500	18800	19100	19400	19700	19950	20250	20540	20800	21090	21340	21580
	Speed	249.0	253.0	257.0	261.0	265.0	269.0	272.5	276.0	280.5	284.0	287.0	291.0
36.	Power	1045.0	1100.0	1152.0	1207.0	1261.0	1318.0	1374.0	1434.0	1490.0	1550.0	1613.0	1667.0
	Water	22000	22400	22730	23100	23420	23750	24100	24450	24790	25100	25400	25700
	Speed	228.0	232.0	236.0	239.0	243.0	247.0	250.0	253.0	257.0	260.0	263.0	267.0
39.	Power	1229.0	1290.0	1352.0	1417.0	1480.0	1548.0	1613.0	1685.0	1750.0	1817.0	1892.0	1955.0
	Water	25820	26270	26700	27100	27500	27900	28300	28700	29080	29440	29800	30150
	Speed	211.0	214.0	217.3	221.0	224.5	227.5	231.0	234.0	237.3	241.0	243.0	246.0
42.	Power	1423.0	1497.0	1569.0	1642.0	1717.0	1793.0	1870.0	1945.0	2023.0	2110.0	2188.0	2270.0
	Water	29990	30450	30990	31430	31900	32340	32800	332500	33700	34180	34590	35000
	Speed	195.5	199.0	202.0	205.0	208.5	211.0	214.5	217.5	220.5	223.0	226.0	229.0
45.	Power	1634.0	1717.0	1800.0	1886.0	1950.0	2060.0	2148.0	2235.0	2320.0	2420.0	2512.0	2600.0
	Water	34400	34950	35550	36100	36600	37100	37650	38200	38650	39200	39700	40100
	Speed	182.5	185.5	188.5	191.0	194.5	197.2	200.0	203.0	205.5	208.5	211.0	213.5
48.	Power	1858.0	1953.0	2048.0	2145.0	2242.0	2342.0	2435.0	2540.0	2640.0	2750.0	2855.0	2960.0
	Water	39150	39780	40450	41100	41650	42250	42800	43450	44000	44600	45120	45620
	Speed	171.0	174.0	177.0	179.0	182.4	185.0	187.5	190.0	192.5	195.0	197.5	200.0
51.	Power	2100.0	2207.0	2311.0	2421.0	2530.0	2645.0	2745.0	2866.0	2980.0	3105.0	3225.0	3346.0
	Water	44120	44850	45600	46300	47000	47600	48350	49000	49700	50350	51000	51550
	Speed	161.0	164.0	166.5	169.0	172.0	174.0	176.5	179.0	181.5	184.0	186.0	188.5
54.	Power	2353.0	2473.0	2592.0	2716.0	2838.0	2950.0	3080.0	3215.0	3340.0	3480.0	3610.0	3745.0
	Water	49550	50350	51150	52000	52700	53400	54150	54950	55700	56450	57100	57750
	Speed	152.0	154.5	157.0	159.5	162.0	164.5	167.0	169.0	171.5	173.5	176.5	178.0
57.	Power	2623.0	2756.0	2890.0	3028.0	3150.0	3290.0	3435.0	3580.0	3722.0	3875.0	4027.0	4175.0
	Water	55150	56050	57000	57950	58700	59500	60400	61200	62000	62850	63650	64400
	Speed	144.0	146.5	149.0	151.0	153.5	156.0	158.0	160.0	162.5	164.5	166.5	168.5
60.	Power	2904.0	3052.0	3200.0	3350.0	3490.0	3640.0	3805.0	3973.0	4130.0	4300.0	4465.0	4630.0
	Water	61180	62160	63200	64100	65000	65950	66950	67900	68800	69700	70550	71400
	Speed	137.0	139.2	141.5	143.5	146.0	148.0	150.0	152.0	154.0	156.0	158.0	160.0

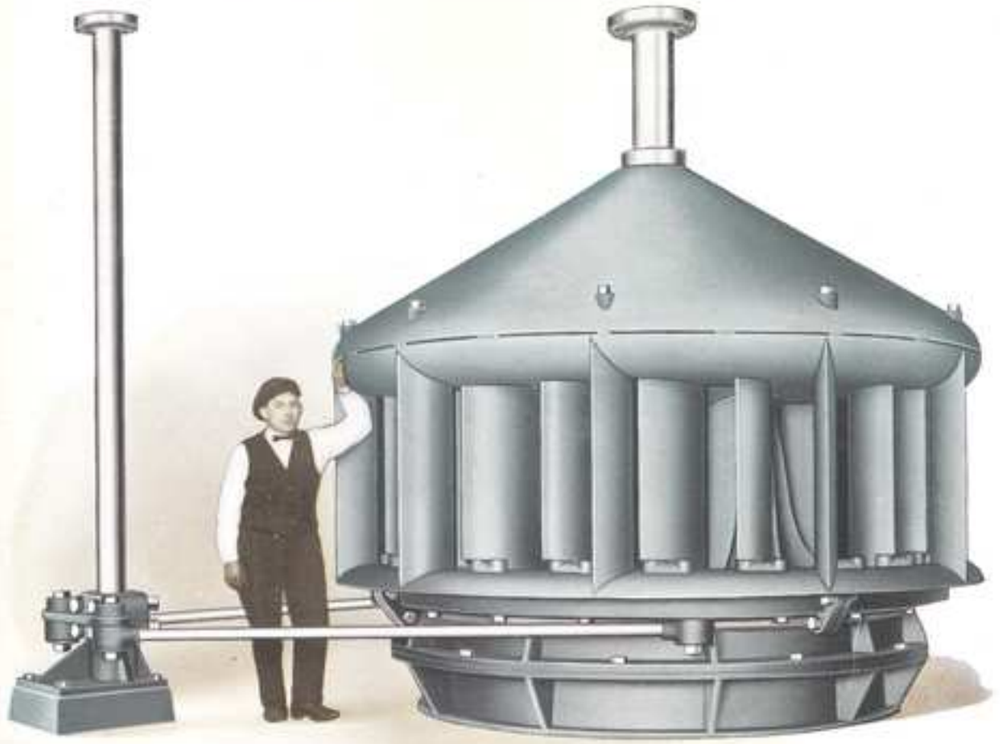
EXPLANATION OF ABOVE TABLES

HEAD = Effective head in feet. WATER = Cubic feet discharged per minute.
POWER = Full gate horsepower. SPEED = Number of revolutions per minute.

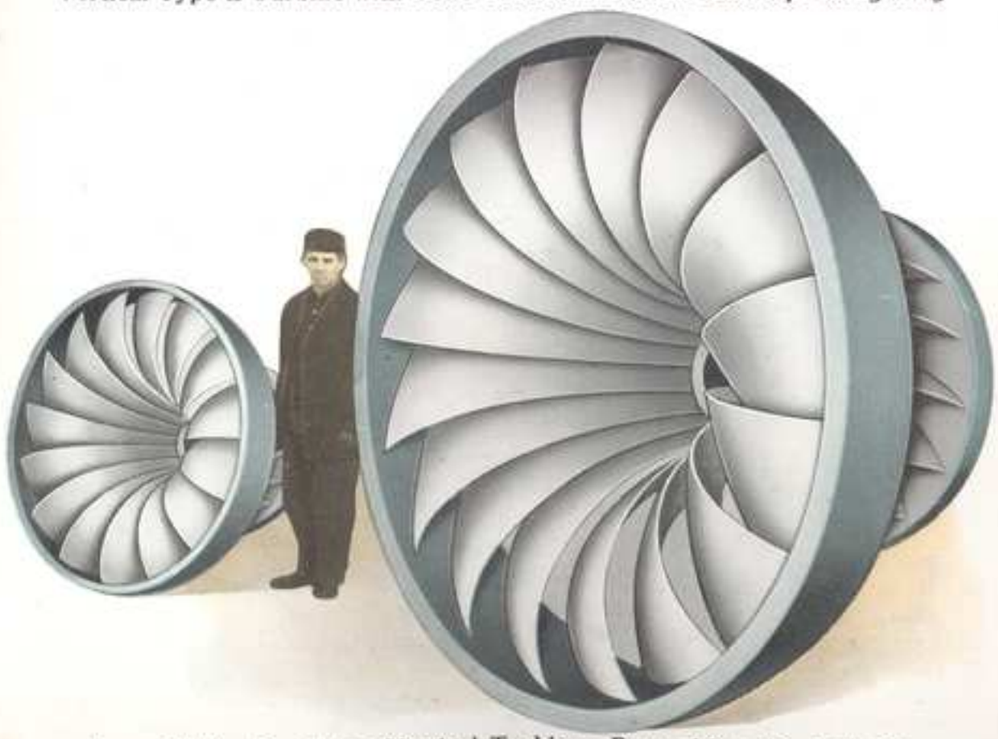
These vertical TYPE Z turbines to develop above power, speed and efficiency values, must be installed and operated substantially as given on page 15.

We also build these TYPE Z turbines developing different power and speed values than given in above tables, for which we will furnish special particulars.

Large Capacity Vertical Type Z Turbines

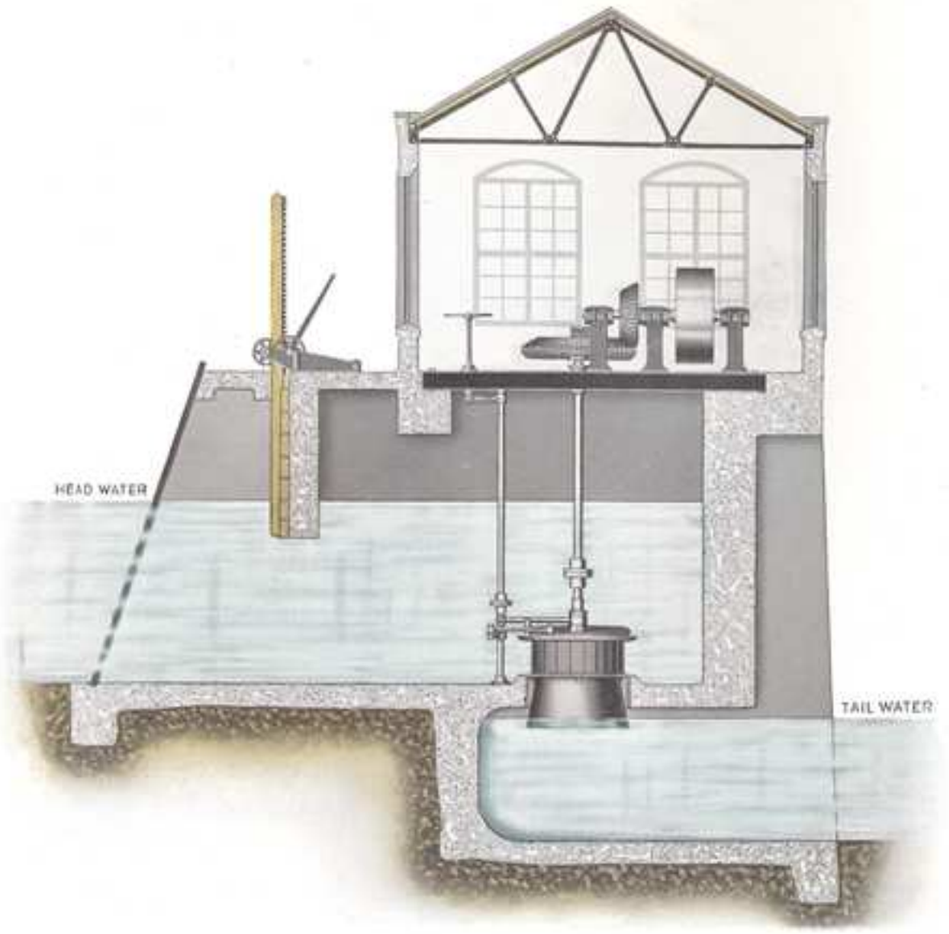


Vertical Type Z Turbine with Cone Cover and Bottom Gate Operating Ring



Power Tables For These Vertical Turbines, Pages 16 to 18, Inclusive

Vertical Samson Turbines in Open Penstocks



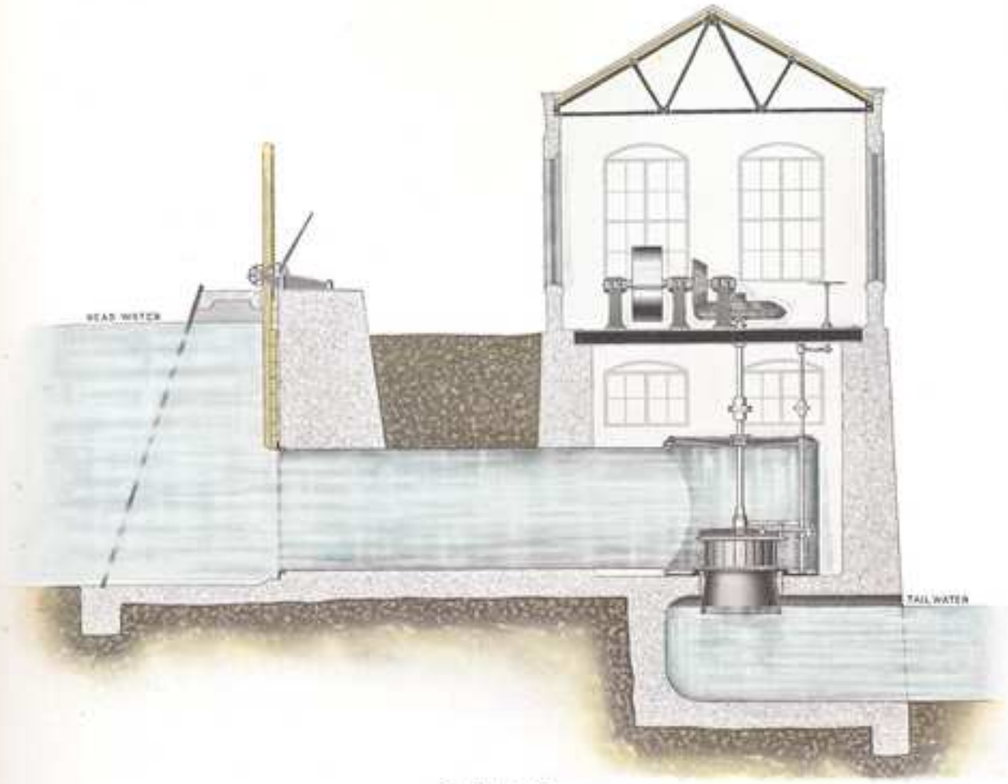
Design 40

This illustrates the installment of our vertical SAMSON turbines with top gate operating ring in open penstock. The vertical gate shaft rotates 45° to 60° full gate movement. We sometimes build these turbines with gate operating ring located below the turbine gates as illustrated, page 22. These vertical turbines are usually furnished with our regular design conical discharge cylinder as illustrated. Frequently we build these turbines with short base rings for special draft tubes.

We also design and build all sizes and arrangement of power transmission machinery, shafting, couplings, bearings, gearing, cast iron bridge-trees, steel beam construction, belt and rope driving pulleys. All shafting made of open-hearth steel, large shafts forged steel. All gray iron castings made of the very best grade of pig iron. All materials used by us in the construction of our turbines and machinery are of the highest qualities throughout. We analyze and test all materials used by us in the construction of our work.

We also furnish all styles and sizes of head gate hoisting irons.

Vertical Samson Turbines in Steel Flumes



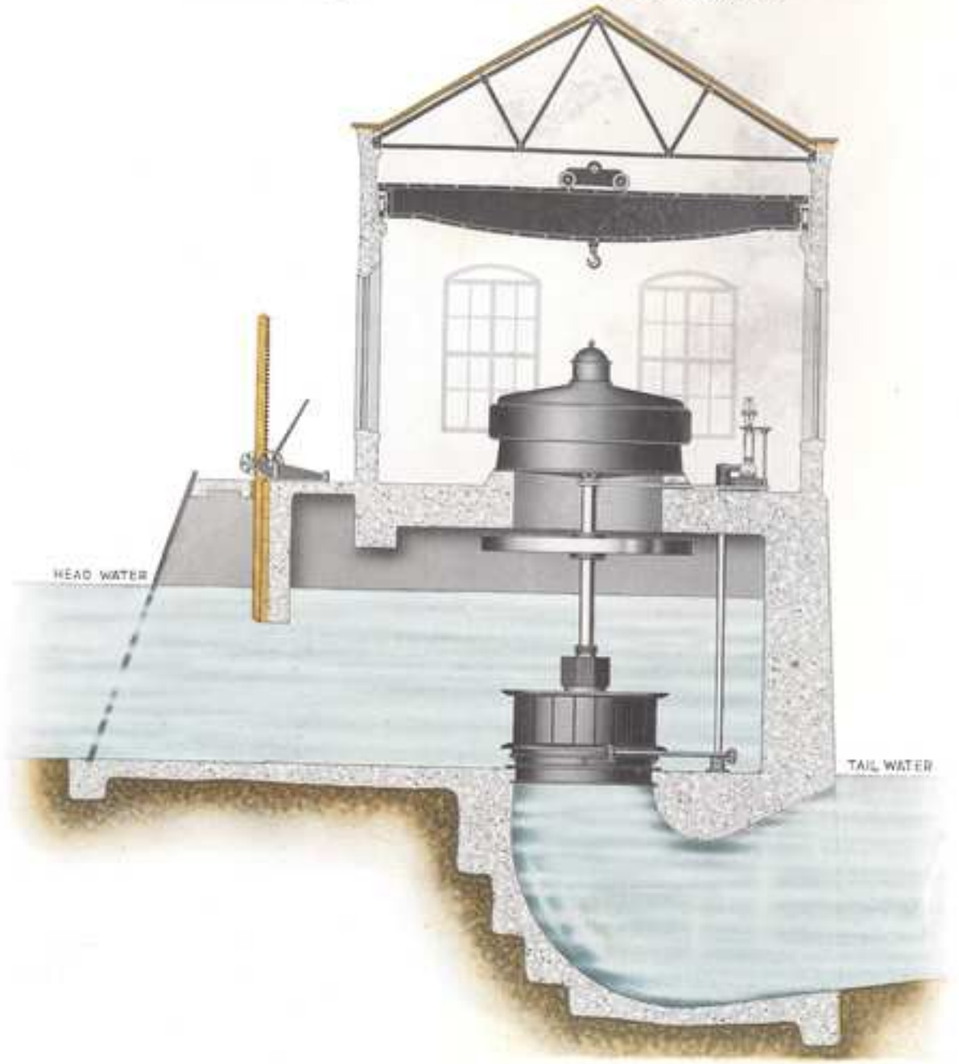
Design 41

Frequently steel flumes and steel feeder pipes can be installed much more economically and to better advantage than open penstock installment as illustrated on page 20. We build all sizes of steel flumes and feeder pipes. The dimension of these steel flumes for our vertical standard SAMSON turbines are given in table on page 8. We build these steel flumes in one piece up to 10 feet diameter. Larger diameters we build split, necessary for transportation, and arranged for bolting and riveting together when installing to position. We completely erect in our shops these steel flumes and feeder pipes, together with the turbines and accessories, then carefully and plainly mark each piece before knocking down for shipment. These steel flumes have top removable covers with adjustable stuffing boxes for turbine and gate shafts, also large manholes with bolted covers, top and bottom heads cast iron heavily ribbed.

We furnish riveted steel feeder pipes of all diameters and thicknesses of plate and of different designs and arrangements to suit location and requirements. All rivets are carefully fitted and driven with special pneumatic tools, and all joints are properly fitted and calked. All of our work before shipment is marked in detail and thoroughly covered with hydraulic paint. We have a complete up-to-date boiler shop and equipment for this particular work. All machine tools of latest design and driven electrically.

Give us an opportunity to submit estimates on your requirements.

Vertical Type Z Turbines Direct Connected

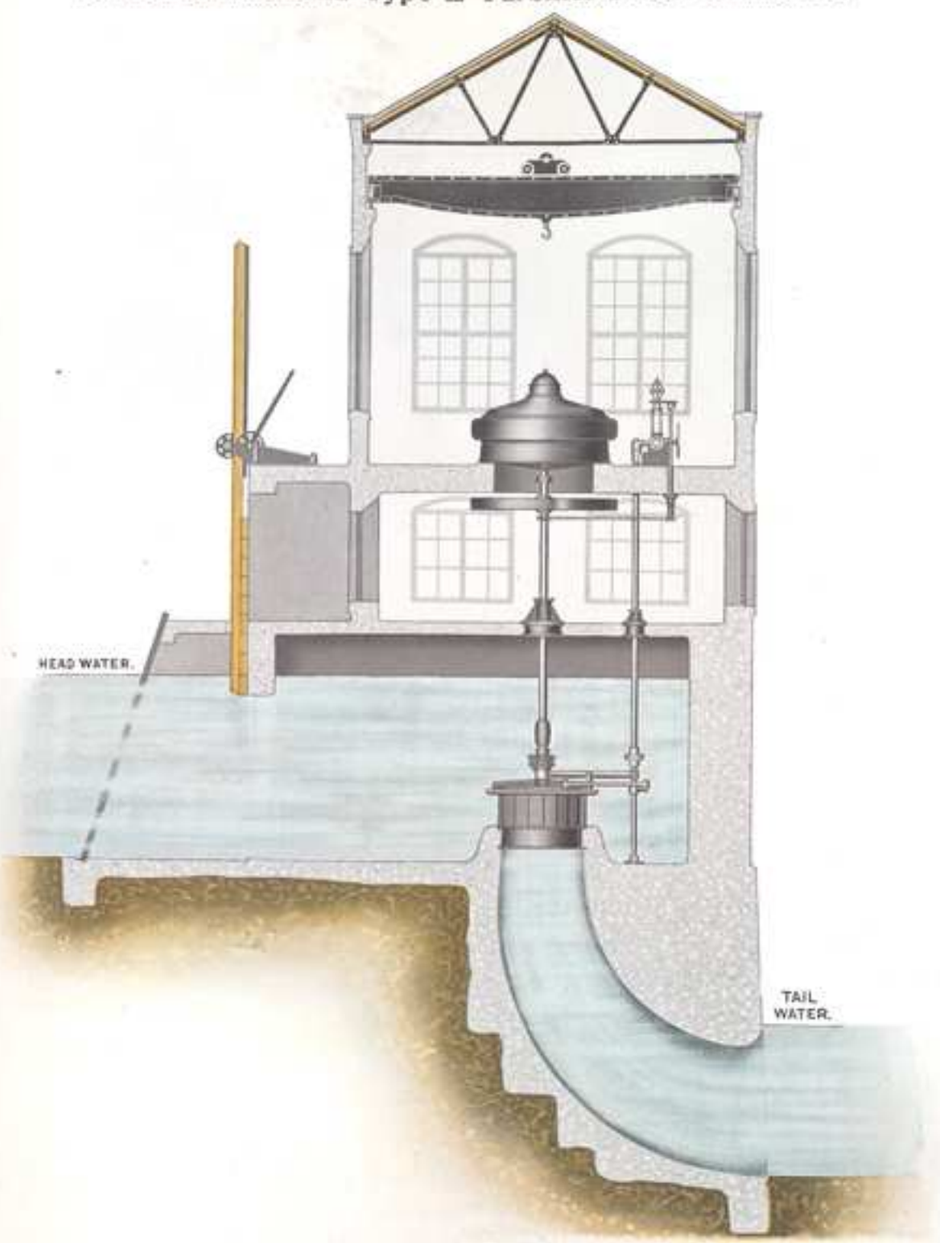


Design 52

This illustrates our high-power, high-speed, high-efficiency vertical TYPE Z turbine installed under low head and direct connected to generator. Turbine fitted with our improved bottom gate operating ring direct connected to vertical gate shaft that rotates 45° or 60° for full gate travel. Gate shaft connected directly to oil pressure governor driven from turbine shaft. The governor pressure pump may be motor or belt driven. Frequently, to assist speed regulation, it is necessary to install on turbine shaft heavy balance wheel as illustrated. The weight of all revolving parts of complete unit carried on suitable thrust bearing located on top of generator. If unit is properly erected, one man can easily rotate the revolving parts. This means highest efficiencies and lowest operating expense. We have many of these units running.

These turbines, to develop power table values, must be installed and operated substantially as shown on page 15. We will furnish complete drawings, together with specifications and operating instructions.

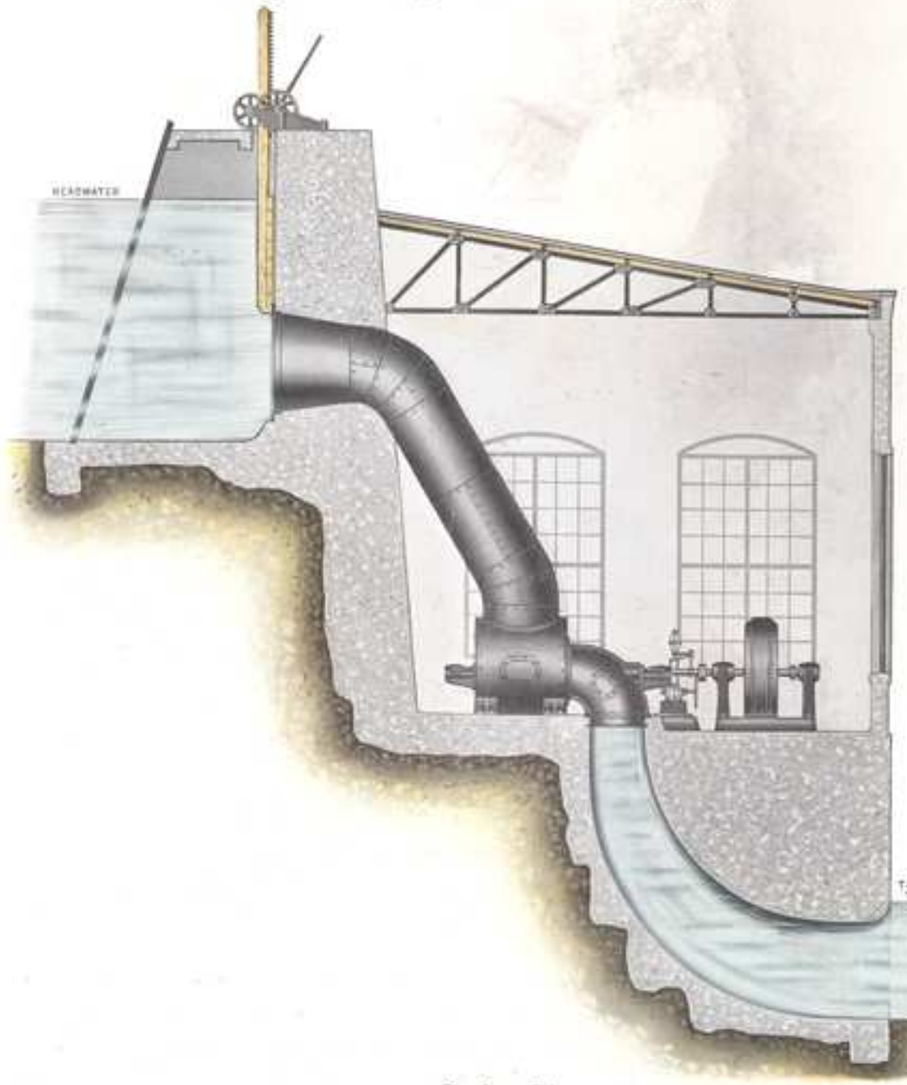
Vertical Samson and Type Z Turbines Direct Connected



Design 50

For high efficiency vertical direct connected installments our various SAMSON and TYPE Z turbines are especially adapted. We design our turbines to develop highest efficiencies at all gateages, running constant speed under variable heads. Refer to Constant Speed Tables on page 5. Frequently these turbines are installed in scroll design open penstocks, also in steel flumes and cast iron scroll or volute casings. Generally concrete draft tubes are used. When required, we furnish steel draft tubes of any size and design. We also build these high-speed turbines horizontal design for belt transmission or direct connected.

Single Discharge Horizontal Turbines



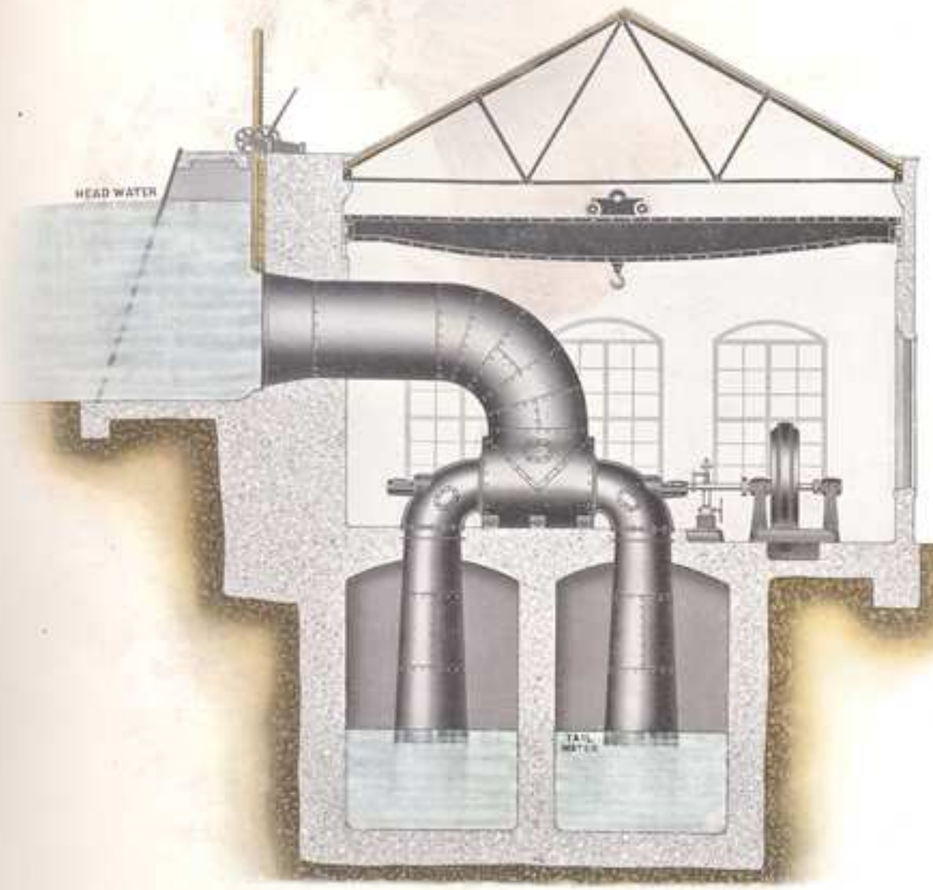
Design 24

We furnish these single discharge horizontal turbines either for direct connection or with driving pulleys, with feeder pipe connection on top of flume as illustrated, or on one side or end of flume opposite discharge end. The water pressure thrust on turbine shaft is satisfactorily carried in suitable thrust bearing in combination with ring-oiling bearing which carries turbine shaft. No turbine shaft bearings inside of flume.

We also build these turbines with cast iron scroll or volute casings for medium and high heads. Also, we frequently sectionalize these turbines for mule-back transportation. We also furnish steel draft tubes if required, together with quick-acting governors. Sometimes we furnish balance wheels on turbine shafts to assist speed regulation.

We furnish curve tables giving guaranteed power, speed and efficiency values, also speed regulation under variable heads and load changes.

Double Discharge Horizontal Turbines

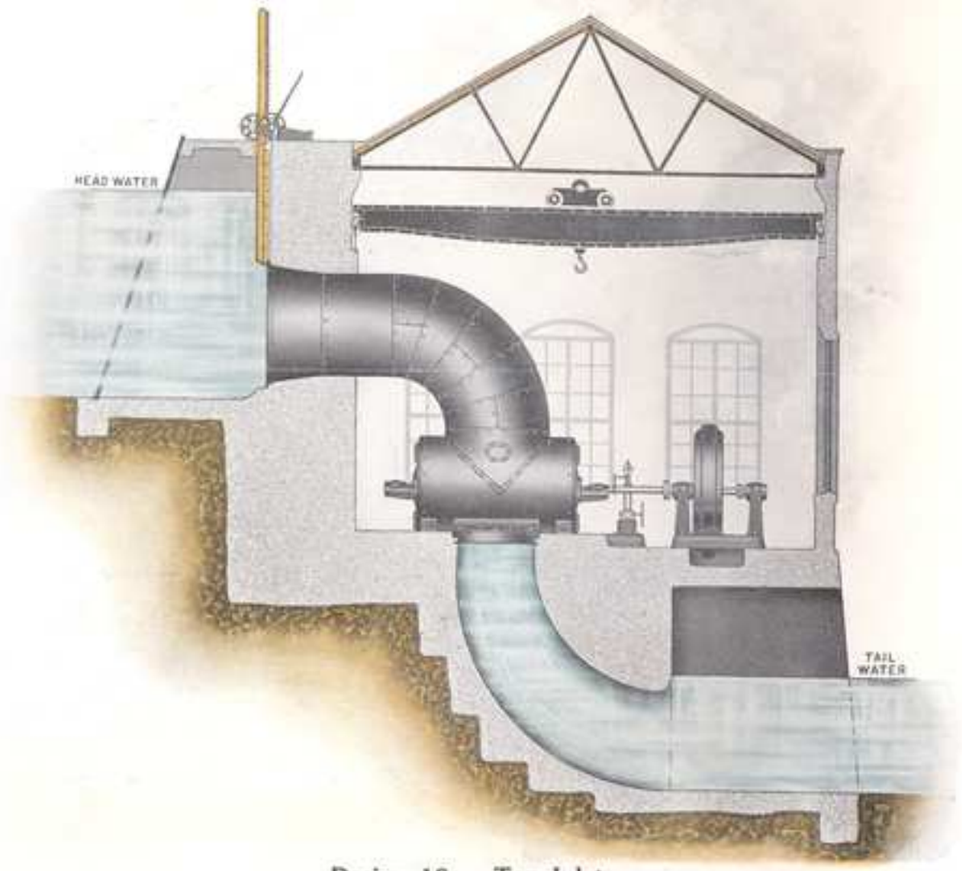


Design 21

We build this design of horizontal turbines equipped with our different SAMSON or TYPE Z turbines for direct connection or belt transmission, and fitted with two separate turbine runners and gate casings. Each runner discharges into elbow with draft tube. Both runners fitted on one horizontal shaft. Sometimes this shaft is made in two pieces coupled together between runners. We usually build both gate casings connected to one gate shaft, both gate casings operating together. Or, each gate casing connected to separate gate shafts, one gate shaft fitted with hand operating wheel, the other gate shaft connected to governor, or both gate shafts connected to governor as required. By this arrangement both turbines will run together or only one turbine run to suit available water. This means using the different quantities of water up to maximum capacity of turbines at highest efficiencies. We also build these turbines with scroll or volute casings for medium and high heads. The feeder pipe may be connected on top as illustrated, or on side of flume. We furnish turbine shaft with suitable thrust bearing in combination with turbine shaft ring-oiling bearings located outside of discharge elbows. These turbines can be installed on concrete draft tubes.

We furnish governors and accessories for complete installment.

Center Discharge Horizontal Turbines Top Inlet



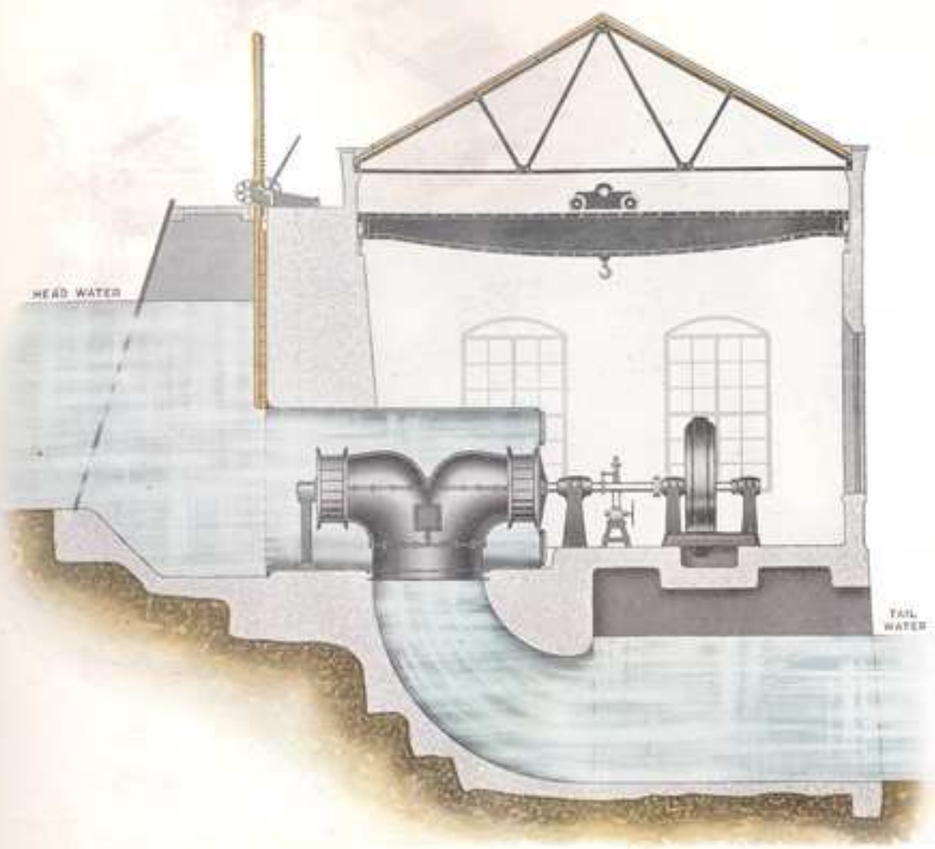
Design 19 — Top Inlet

For medium and higher heads and with sufficient water for running each turbine unit to capacity, this design of turbine can be most advantageously installed and operated at minimum cost. In this design of horizontal turbine both runners are fitted on one continuous turbine shaft. Both gate casings direct connected to one gate shaft which rotates 45° or 60° for full gate travel. The end of gate shaft direct connected to governor with suitable arrangement so governor can be disconnected and gate shaft hand operated if required. Where head of water permits, the feeder pipe can be located on top of flume as illustrated, or connected to side of flume. Frequently, to better suit location, the end of flume is extended into forebay as shown on page 27. These turbines can be fitted with either concrete or steel draft tubes. Sometimes we furnish our horizontal turbines mounted on steel beams. Frequently without steel beams and bolted directly on concrete foundation as illustrated. The flumes are fitted with large manholes, also suitable drain valves together with adjustable stuffing boxes for turbine and gate shafts.

With our different types of turbine runners and gate casings, we can furnish horizontal turbines developing almost any power and speed values that may be required installed under low, medium and high heads.

Give us full particulars regarding your proposed turbine installment.

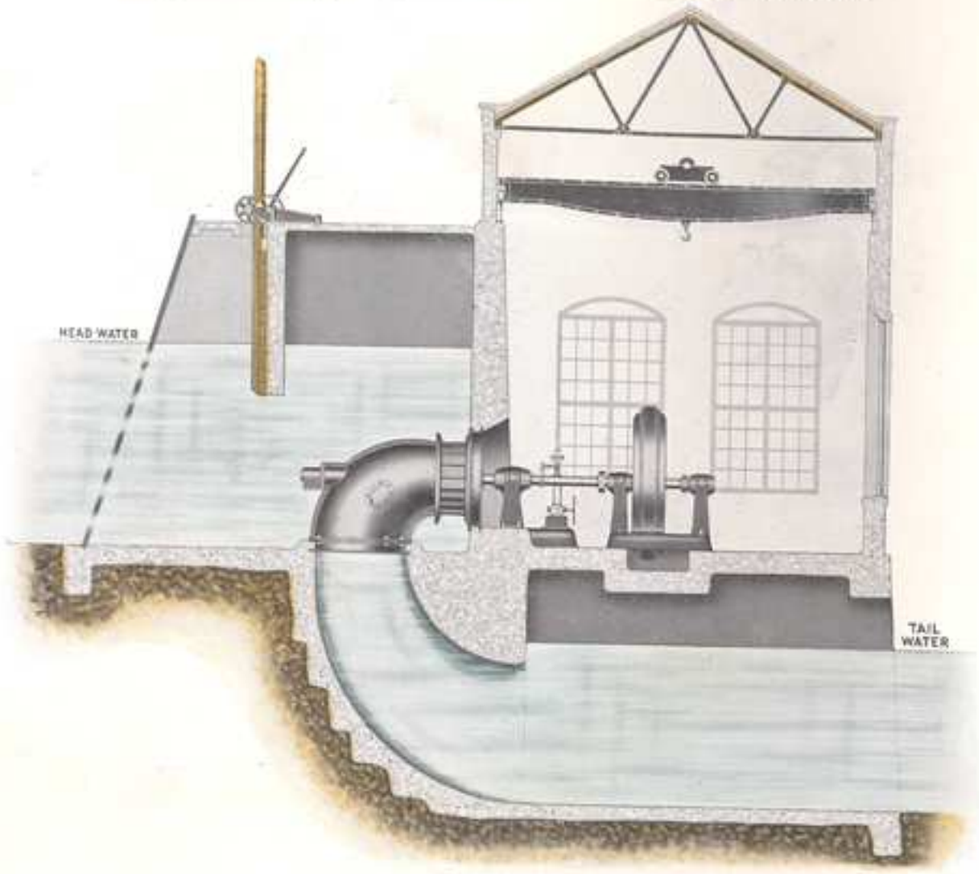
Center Discharge Horizontal Turbines End Inlet



Design 19 — End Inlet

The same detailed specifications as given on page 26 also practically covers this type of turbine, excepting end inlet arrangement as illustrated above. Frequently we furnish these turbines with steel beams designed to suit the building foundations, also without steel beams as shown above. The center casing into which both turbines discharge is made of cast iron in sections bolted together, convenient for handling. The base ring on which the center discharge casing is mounted, can be arranged for either steel or concrete draft tubes. This turbine is so designed that all inside parts including turbine shaft with runners, gate casings and center discharge casing can be removed through the flume head, out on to power house floor, without disturbing the steel flume. The illustration also shows large head gate closing immediately over inlet end of flume. This head gate is raised and lowered with suitable hoisting irons located on foundation above head water. Small flood gates should be built in these large head gates so that when the head gates are closed and with full water pressure against the head gates, these flood gates can be opened and the flume filled with water, then the head gates can be easily hoisted. We furnish all designs and sizes of head gate hoisting irons. All installments should be equipped with steel screen rack located in head water in forebay to keep trash and debris out of the turbines, thereby eliminating danger of breakage and interference with movement of turbine gates.

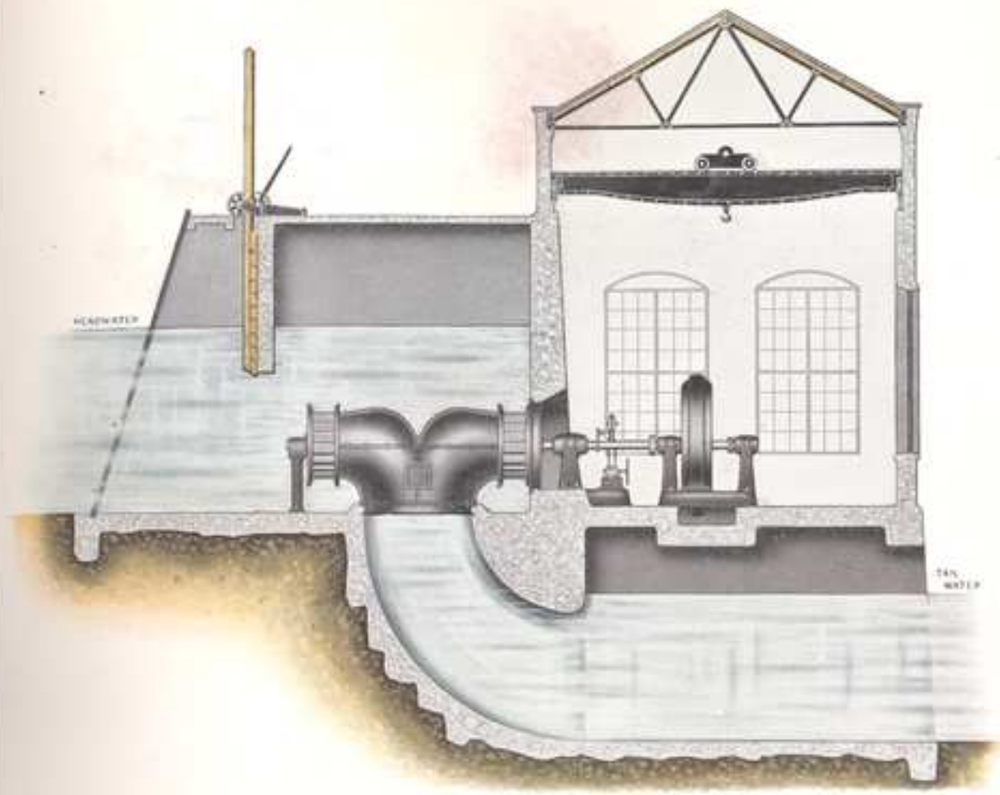
Single Discharge Open Penstock Horizontal Turbines



Design 25

This design of horizontal turbine is largely used for driving exciters and other small capacity, high speed machinery installed in connection with large power units in open penstock construction as illustrated on pages 29 and 30. This design of horizontal turbine can be furnished and installed at comparatively low cost. We build our SAMSON and TYPE Z turbines this design. We frequently build this same design of turbine so arranged that the turbine runner and gate casing are located in the head water in the penstock, and the discharge cylinder ring built in the bulkhead wall, with the discharge elbow located on power house floor and shaft extended either for direct connection or belt transmission. This arrangement of turbine we specify our Design 26. Drawings and details of same furnished as required. These turbines are fitted with our improved runners and with gate casings direct connected to gate shaft arranged for connection to governor, or with operating hand wheel. We equip our horizontal turbines with our special design collar thrust bearing built in combination with turbine shaft bearing. These bearings are ring-oiling heavy pattern and lined with special metal. When thrust is heavy we build these bearings water-cooled design. These thrust bearings have proven most satisfactory. We furnish turbine bearings of all designs and sizes for both vertical and horizontal shafts.

Center Discharge Open Penstock Horizontal Turbines



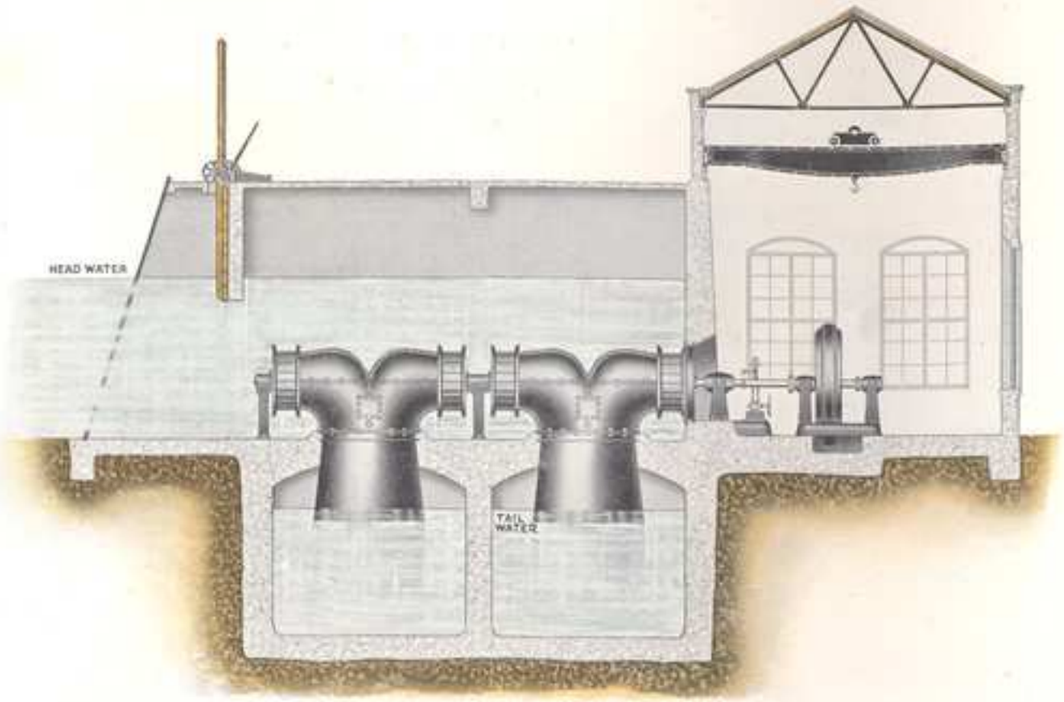
Design 22

This is a popular design of turbine unit for open penstock installment, developing high speed, high power and high efficiencies, either for direct connection or with belt or rope transmission. Both turbines are mounted on horizontal shaft and discharge into center casing made in sections bolted together and mounted on draft tube base ring. These center discharge casings are made heavy, substantially ribbed and fitted with large manholes with bolted covers. The gate casings are equipped with our latest design of balanced gates direct connected to governor, or fitted with hand wheel. The gate shaft can be located on either side, or on top of turbines to suit requirements. To develop greater horsepower per unit, these turbines are frequently built tandem like illustration, page 30. We have made extensive tests of these horizontal turbines and are fully advised how best to design and build these turbines for developing maximum hydraulic values and best commercial results.

We also furnish various types and sizes of governors which will develop when correctly installed and operated, entirely satisfactory speed regulation under variable heads and load changes. Sometimes a balance wheel is required to assist speed regulation.

We furnish curve tables giving guaranteed speed regulation for any of our turbines installed and operated under all conditions.

Tandem Center Discharge Open Penstock Horizontal Turbines



Design 22 — Tandem

These horizontal turbines are the same design as the single pair on page 29. The above illustration shows two pairs of these turbines connected tandem. By this arrangement heavy horsepower at high speed is developed under low and medium heads of water, for direct connection to generators and other high-speed machinery. This illustration shows the gate casings connected to one horizontal gate shaft. Frequently, to suit variable quantities of water, we furnish each pair of turbines with a separate gate shaft. By this arrangement the gates on either pair of turbines can be operated independently, or both gate shafts operated together. These gate shafts connected together with a cross rod and pin clutch directly connected to governor. Therefore, the gates on both pairs of turbines would be operated together by the governor. Or, by disengaging the pin clutch, the gates on one pair of turbines can be closed, leaving the remaining pair of turbines running. This makes a most flexible installment and is largely used. The illustration shows steel draft tubes. We also build these turbines with base rings suitable for concrete draft tubes. The bearings supporting turbine shaft located in the head water are usually lignumvitae with bronze adjusting screws.

Some times we build these turbines with 3 or 4 pairs tandem.

All parts of our turbines are built strong and substantial, of strictly first-class material and workmanship throughout, and of our latest designs in all details. We fully guarantee our turbines in every particular.

We build many other types and designs of turbines both vertical and horizontal not illustrated or described in this Bulletin.

Different Methods With Instructions For Measuring Water

Measuring Flow of Water by Weir Method

After deciding upon suitable location for the new power plant, the following preliminary measurements must be obtained:

FIRST, obtain in feet the head of water. This is the vertical distance from the surface of water above dam down to the tail water surface below dam at the place where turbines will be located.

SECOND, obtain minute cubic feet of water. Several methods may be used, the easiest and most commonly used methods are as follows:

If the stream is large, select place where water flows slowly for some distance between parallel banks and where the bottom of stream is fairly even. Then carefully space and measure the cross sectional area of water in square feet. Then place a float that sinks well down into the water in the center of stream and accurately measure the distance in feet the float travels in one minute. Then multiply this distance by the cross sectional square feet area, and eighty-three per cent of this result will be approximately the minute cubic feet of water flowing in the stream. Or,

If the stream is small the water can be measured by weir. (See the above illustration.) Select first a suitable location in stream where water flows slowly, then place a board with notch in same, forming a weir dam; the down stream edge of weir notch beveled almost to a sharp edge; the width B must be about six times the greatest depth of water flowing over weir. The bottom edge of weir not less than one foot above

(Continued on page 32)

Table Giving Minute Cubic Feet of Water 1 Inch Wide Flowing Over Weir

Inches Depth C Over Stake	1/8 Inch	1/4 Inch	3/8 Inch	1/2 Inch	5/8 Inch	3/4 Inch	7/8 Inch
1 Inch	.40	.47	.55	.65	.74	.83	.93	1.03
2 "	1.14	1.24	1.36	1.47	1.59	1.71	1.83	1.96
3 "	2.09	2.23	2.36	2.50	2.63	2.78	2.92	3.07
4 "	3.22	3.37	3.52	3.68	3.83	3.99	4.16	4.32
5 "	4.50	4.67	4.84	5.01	5.18	5.36	5.54	5.72
6 "	5.90	6.09	6.28	6.47	6.65	6.85	7.05	7.25
7 "	7.44	7.64	7.84	8.05	8.25	8.45	8.66	8.86
8 "	9.10	9.31	9.52	9.74	9.96	10.18	10.40	10.62
9 "	10.86	11.08	11.31	11.54	11.77	12.00	12.23	12.47
10 "	12.71	12.95	13.19	13.43	13.67	13.93	14.16	14.42
11 "	14.67	14.92	15.18	15.43	15.67	15.96	16.20	16.46
12 "	16.73	16.99	17.26	17.52	17.78	18.05	18.32	18.58
13 "	18.87	19.14	19.42	19.69	19.97	20.24	20.52	20.80
14 "	21.09	21.37	21.65	21.94	22.22	22.51	22.79	23.08
15 "	23.38	23.67	23.97	24.26	24.56	24.86	25.16	25.46
16 "	25.76	26.06	26.36	26.66	26.97	27.27	27.58	27.89
17 "	28.20	28.51	28.82	29.14	29.45	29.76	30.08	30.39
18 "	30.70	31.02	31.34	31.66	31.98	32.31	32.63	32.96
19 "	33.29	33.61	33.94	34.27	34.60	34.94	35.27	35.60
20 "	35.94	36.27	36.60	36.94	37.28	37.62	37.96	38.31
21 "	38.65	39.00	39.34	39.69	40.04	40.39	40.73	41.09
22 "	41.43	41.78	42.13	42.49	42.84	43.20	43.56	43.92
23 "	44.28	44.64	45.00	45.38	45.71	46.08	46.43	46.81
24 "	47.18	47.55	47.91	48.28	48.65	49.02	49.39	49.76

the surface of water below the down-stream side of weir. Then drive a stake up stream several feet above weir. The top of stake must be exactly level with bottom edge of weir. When all water is flowing over weir, measure the depth C over top of stake, then read above weir table which gives the minute cubic feet of water 1 inch wide flowing over weir. Example: Assume width B of weir as 70 inches, depth C as 12½ inches. Look down the first column in weir table to 12 inches, then horizontally to column under ½ inch. The minute cubic feet flowing over weir 1 inch wide, 12½ inches deep will be 17.78 multiplied by 70 inches, the result is 1244.60 minute cubic feet flowing over weir.

The horsepower of the minute cubic feet of water thus obtained for any head up to 50 feet given in power tables, pages 10 to 13, inclusive.

If water is measured by miner's inch method, give us the number of miner's inches of water per minute, together with the head of water. We then will advise the horsepower that can be developed by our turbines.

Send us full measurements and particulars regarding proposed new turbine installment. We will reply promptly with full information.